

## DOCUMENT RESUME

ED 442 675

SE 063 817

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TITLE An Examination of the Enculturation of Five Reform-Prepared  
New Specialist Teachers of Mathematics and Science..  
SPONS AGENCY National Science Foundation, Arlington, VA.  
PUB DATE 2000-04-00  
NOTE 53p.; Paper presented at the Annual Meeting of the American  
Educational Research Association (New Orleans, LA, April  
24-28, 2000).  
CONTRACT DUE9255745; DUE9814650  
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)  
EDRS PRICE MF01/PC03 Plus Postage.  
DESCRIPTORS \*Beginning Teachers; Case Studies; \*Cultural Influences;  
Elementary Secondary Education; \*Mathematics Instruction;  
Mathematics Teachers

## ABSTRACT

This study's purpose was to present a detailed description and interpretation of what happens to new teachers in schools who are prepared to enact reform-based practices in mathematics and science. The focus was on a select sample of graduates from the Maryland Collaborative for Teacher Preparation [MCTP], a statewide reform-based undergraduate teacher preparation program supported by National Science Foundation funding. A case study methodology was used (first year, N=5; second year, N=3). Differential experiences and perceptions of and by new specialist teachers of mathematics were documented. Analysis was based on a teacher socialization framework as suggested by S. Veenman. Discussion centered on the enculturation of the teachers into an extant teaching culture (school district and school). Insights were framed in two components: (1) the individual's intentions, needs, and capabilities; and (2) the institutional demands, supports and constraints. A major finding was that the new teachers' school cultures were a major factor in whether reform-aligned mathematics and science teaching was regularly implemented by the new teachers. In addition, the new teachers' perceptions of their school cultures' lack of support of their intent to implement reform-based practices prompted differing social strategies by the new teachers (resistance, moving on, and exit). If these findings are supported by future research, then in order to enact reform and to retain new reform-prepared teachers in schools, more attention needs to be placed on how to foster supportive, reform-oriented school cultures. (Contains 36 references.) (Author/ASK)

# An Examination of the Enculturation of Five Reform-Prepared New Specialist Teachers of Mathematics and Science

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## Abstract

This study's purpose was to present a detailed description and interpretation of what happens to new teachers in schools who are prepared to enact reform-based practices in mathematics and science. The focus was on a select sample of graduates from the Maryland Collaborative for Teacher Preparation [MCTP], a statewide reform-based undergraduate teacher preparation program supported by National Science Foundation funding. A case study methodology was used (first year, N=5; second year, N=3). Differential experiences and perceptions of and by our new specialist teachers of mathematics were documented. Analysis was based on a teacher socialization framework as suggested by Veenman (1984). Discussion centered on the enculturation of the teachers into an extant teaching culture (school district and school). Insights were framed in two components: the individual's intentions, needs, and capabilities, and the institutional demands, supports and constraints. A major finding was that the new teachers' school cultures was a major factor in whether reform-aligned mathematics and science teaching was regularly implemented by the new teachers. In addition, the new teachers' perception of their school cultures' lack of support of their intent to implement reform-based practices prompted differing social strategies by the new teachers (resistance, moving on, and exit). Therefore, if our findings are supported by future research, to enact reform and to retain new reform-prepared teachers in schools a key implication is that more attention needs to be placed on how to foster supportive, reform-oriented school cultures.

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## An Examination of the Enculturation of Five Reform-Prepared New Specialist Teachers Of Mathematics and Science

This study investigates the enculturation over a one and half-year period of new upper elementary/middle school specialist teachers of mathematics and science (first year, N=5; second year, N=3) in a diverse Northeastern US public school district. These teachers graduated from a reform-based undergraduate teacher education program, the Maryland Collaborative for Teacher Preparation (MCTP).

The well-spring of this study is an indepth examination of a model of teacher preparation based on collaboration among colleges, school systems, and the private sphere that seeks to prepare and support a new generation of classroom teachers who can survive the challenge of theory to practice (Kirschner, 1996). Anderson and Mitchener's (1994) review of science teacher preparation emphasized that teacher education is a long-term process with several critical components that form a whole in the individual teacher's career development. While it is still assumed that what occurs in college undergraduate classes is vital, it is now believed that the kind of experiences and the type of interactions the teacher candidates (and later as new teachers) have with professionals in the world of work (K-12 schools and summer intern contexts rich in mathematics and science) and their perceptions of their workplace cultures are also vital in any effective teacher preparation and induction program (Richmond, 1996).

This study is conducted within a macro-research agenda within the mathematics and science education research communities that focuses on the possible links between features of teacher preparation programs and the performances of new teachers (Simmons, et al., 1999). Currently, little is known in this context of reform about how newly graduated specialist teachers of mathematics and science from innovative teacher preparation programs are inducted into cultures of extant practice (Coble & Koballa, 1996). Pekarek, Krockover and Shephardson (1996) asserted that research-based insights of most value will come from studying teacher preparation programs that are seeking to implement recommended innovations in teacher preparation.

### Context of the Study

The MCTP is a National Science Foundation (NSF) funded statewide undergraduate program for students who plan to become specialist mathematics and science upper elementary or middle level teachers. While teacher candidates selected to participate in the MCTP program in many ways are representative of typical teacher candidates in elementary teacher preparation programs, they are distinctive by agreeing to participate in a program that consists of an extensive array of mathematics and science experiences (formal and informal) that make connections between the two disciplines.

The goal of the MCTP is to promote the development of professional teachers who are confident teaching mathematics and science using technology, who can make connections between and among the disciplines, and who can provide an exciting and challenging learning environment for students of diverse backgrounds (University of Maryland System, 1993). This goal is in accord with the educational practice reforms advocated by the major professional mathematics and science education communities (National Council of Teachers of Mathematics [NCTM], , 1991; American Association for the Advancement of Science [AAAS] 1989, 1993; National Research Council [NRC] of the National Academy of Sciences, 1989, 1996).

The MCTP is designed around these salient reform-based recommendations:

- new content and pedagogy courses that model inquiry-based, interdisciplinary approaches combined with regular opportunities for teacher candidate reflection;
- the participation of faculty in mathematics, science, and methods committed to modeling best teaching practices (especially by diminishing lecture and emphasizing problem-solving);
- the development of field experiences in community schools with exemplary teachers trained to serve as mentors;
- the availability of summer internships in contexts rich in mathematics and science;
- and, the support of new teachers by university and school personnel during their first years of teaching.

### Theoretical Assumption and Research Questions

A fundamental assumption of the MCTP is that changes in pre-secondary level mathematics and science educational practices require reform within the undergraduate mathematics and science subject matter and education classes teacher candidates take throughout their teacher preparation programs (National Science Foundation, 1993). In earlier research (McGinnis, et. al, 1999a; 1999b), we have reported that as teacher candidates the five participants in this study indicated in their discourse and in artifacts (e.g., lesson plans) that they held notions about the nature of mathematics and science, and about the best ways to teach mathematics and science, that are compatible with the MCTP program's reform-minded goals. That is, they intended as classroom teachers to use constructivist instructional strategies, to emphasize connections between mathematics and science, to appropriately use technology when teaching mathematics and science, and to encourage students from diverse backgrounds to participate in challenging and meaningful learning. In this next step in our longitudinal research program, we wanted to determine what happened to our MCTP new teachers' vision of teaching as reflected on their classroom practices and their discourse during their first years of full time teaching. In particular, we wondered if their vision would remain stable or would it change (and if so, how and why)? We were aware that schools are characterized by "dynamic conservatism" (Schön, 1987) in that the dynamic pulls teachers back to a status quo which oftentimes remains unchallenged. We anticipated that the MCTP new teachers' reform-oriented beliefs and actions would run into conflict at times with the status quo and were curious to document and to learn from these as yet unknown situations.

In this study, we focus on answering these highly significant research questions:

1. As they proceed through their induction years, how do new specialist teachers of mathematics and science who graduate from an inquiry-based, standards-guided innovative undergraduate teacher preparation:
  - (a) enact their roles as teachers; and,
  - (b) think about what they do when teaching science and mathematics with upper elementary/middle level students?
2. What supports/constraints impact the introduction of new practices (reform-based) by new specialist teachers of mathematics and science who graduate from an inquiry-based, standards-guided innovative undergraduate teacher preparation?

### Mode of Inquiry

We took a symbolic interactionist theoretical stance in this study (Blumer, 1969; Denzin, 1978). The symbolic interaction theoretical stance makes the assumption that social reality is a social production (Woods, 1992). Meanings are constructed by humans through interaction; meanings are not inherently linked to inanimate objects or events. A central premise is that inquiry must be grounded in the empirical environment under study (van Sickle & Spector, 1996). It also requires the researchers to commit to a significant period of time working in the context of the study. This theoretical position places emphasis on the social construction of meaning in a culture through viewing the process of how individuals define and interpret each other's acts. By carefully examining individual's interpretations of each others acts assertions are made as to how the individual's interpretations of each other sustain or transform the way they view their culture which guides they way they act and interact.

In this study, the symbolic interaction theory provided guidance for the roles of the researchers and the interpretative domain of the study (Goetz & LeCompte, 1984). Since the researchers held the belief that their research was "a social production symbolically negotiated between the researcher and participant" (p. 57) explicitly revealing the purpose of the research to the participants and maintaining an openness of mind regarding interpretations of the participants' beliefs and actions complemented the research methodological approach. Communication between the researchers and with the participants regarding subjective viewpoints became imperative to conduct in order to engage in meaning making within a group, the essence of symbolic interaction. Qualitative research assumes that there are multiple realities constructed as a function of personal interaction and perception (Merriam, 1988, p. 17).

### Literature Review

The induction of science and mathematics teachers is of great interest to the mathematics and science education community, as well as to the larger community concerned with teacher preparation.



Brown and Borko (1992) reviewed extensively the literature on becoming a mathematics teacher through the learning, socialization, and developmental theoretical perspectives. Ryan (1986) and Spector (1989) described and categorized the stages of a science teacher's career. The stages each proposed have some similarities and some differences associated with them.

In summary, Brown and Borko (1992)'s examination of the learning perspective emphasized three teacher knowledge bases hypothesized by Shulman (1986, 1987). Content knowledge, i.e., knowledge of subject matter, pedagogical knowledge, i.e., knowledge of subject matter for teaching, and pedagogical reasoning knowledge, i.e., the process of transforming content knowledge into pedagogically powerful forms appropriate for diverse learners, were all seen as necessary for novice mathematics teachers to possess before they could become successful expert mathematics teachers. The teacher socialization perspective proposed that external forces influenced new teachers as they were inducted into practice. Studies in this genre ranged from functionalist (i.e., the context determined the outcome) to interpretative and critical (i.e., the individual takes an active role in making sense of the context and modifying influences). Finally, the teacher development perspective supposed that a new teacher's development results from changes in cognitive structures, i.e., thinking patterns. While some advocated general patterns in development characterized by being "hierarchical, sequential, and invariant in order" (p. 232), Brown and Borko (1992) disagreed. They suggested that while different developmental stages can be argued to exist when comparing teachers, the different stages were not necessarily based on teaching experience or age.

Ryan (1986) proposed four stages of a science teacher's career: the fantasy stage, the survival stage, the mastery of craft stage, and the impact stage. Each was characterized by special needs, difficulties, and strengths. Ryan's stages were based on the empirical work of Frances Fuller (1969).

Fantasy stage. The fantasy stage exists during preservice preparation and during the early months of first year teaching. During that stage teachers have a romantic and quite unrealistic view of students, what they need to do, and what they can do. Some of the fantasies may be "dark" fantasies as well: feelings of apprehension and bad dreams about teaching.

Survival stage. In approximately October of the first year the survival stage sets in and lasts until at least the winter holiday break or late February but sometimes longer. A change of attitude toward teaching characterizes that stage; the "curve of disenchantment"

sets in (p. 8). Teachers truly and publicly struggle to fulfill their responsibilities and to meet the needs of their students: Fantasy gives way to reality.

Mastery of craft stage. In the mastery of craft stage the new teacher "begins to learn the craft of teaching in a step-by-step fashion" (p. 14). One would hope that appropriate professional development opportunities were available to help teachers in this stage to increase their content knowledge and pedagogical content knowledge and to strengthen and expand their beliefs about teaching as well as to learn general instructional strategies that "work."

Impact. Teachers in the impact stage have not only "hit their stride" in the classroom but are able to give the benefit of their experience and accumulated wisdom to others, both to new teachers and to other colleagues in their school, district, state, and country.

Spector (1989) proposed five stages through which science teachers pass in their professional development: induction, adjustment, maturation, mid-career crisis, and leadership. In observation and interviews with 309 science teachers over a seven year period, she found evidence of those stages in the following changes: in focus of attention and behavior; in self-confidence, in decision-making abilities, in instructional decisions; in perceptions of their sphere of influence; and in relationships with students, teachers, administrators, parents, and university faculty (p. 62).

Induction. Teachers during their induction years focus on survival, are textbook bound, use teaching methods similar to those of their university professors, and view their own classroom as their sphere of influence. They see most of the relationship with others in their school community as adversarial in part because of the conflicts they perceive between an "unbridgeable chasm" (p. 63) between their preservice learning and the realities of their classroom.

Adjustment. Teachers focus on subject matter in the adjustment stage; the structure of their particular discipline guides their instruction. They begin to make "instructional trade-offs" (p. 63) in order to cover material. Although they still mainly depend on the textbook, they begin to expand their repertoire of instructional approaches. They still view the classroom as their sphere of influence. Although they

continue to have we/they interactions, they begin to respond to student needs and begin to collaborate with other teachers. However, they are very intolerant of others with different beliefs about teaching.

Maturation. Teachers in the maturation stage of their professional development are "self-actualizing, confident, secure, and at ease" (p. 64). They now can present a concept in many ways and attend to individual student needs; they are more willing to be innovative and are better able to solve problems. Their personal belief systems heavily influence their instructional decisions. Now they consider the classroom and individual students to be their sphere of influence.

Mid-career crisis. Teachers in the mid-career crisis stage again focus on themselves and their survival as they did in the induction stage and have difficulty in making decisions. Spector says, "The isolation of the classroom stimulates a strong desire for adult interaction, variety in their work, and career advancement" (p. 64). Teachers in this stage consider their sphere of influence to be beyond the classroom and "reach out to other adults" (p. 64). Not surprisingly, the mid-career crisis is a time of considering changing position or leaving teaching.

Leadership. The leadership stage of a teacher's career is again a stage of high confidence and great effectiveness in which teachers "pride themselves on consistently making decisions based on their own strong beliefs . . ." (p. 65). Teachers "thrive on new ideas" and are willing to take risks. As they "collaborate with teachers in other schools, districts, and states, and are active in professional associations," they "thrive on the interaction and feedback derived from sharing their expertise with others" (p. 65).

Awareness of stages in a teacher's career is helpful not only to teachers themselves but also to those interested in better understanding the professional development of new educators. Although Ryan and Spector well-describe each of the stages through which teachers progress, they provide little insight about how they believe teachers achieve the transition from one stage to another. That information would be helpful for those who help and plan programs for teachers, particularly new teachers and for those of us interested in learning more about the induction of beginning teachers into extant practices.

#### Problems of Beginning Teachers

Beginning teachers fall into Ryan's (1986) fantasy and survival stages and into Spector's (1989) induction stage. The problems of those teachers, the consequences of their difficulties, and an intertwining of research on learning to teach with that on induction is included in the next portion of the literature review.

Perceived Problems of New Teachers. In an often cited study of the problems of first year teachers, including those knowledgeable in science into extant practices, Veenman (1984) acknowledged the "dramatic and traumatic" nature of the transition from preservice training to the first teaching job (p. 143). He termed that transition "reality shock," a concept used "to indicate the collapse of the missionary ideals formed during teacher training by the harsh and rude reality of everyday classroom life" (p. 143). Veenman cited Müller-Fohrbrodt, Cloetta, and Dann (1978) who suggested five indications of reality shock found in new teachers: in their perceptions of problems, in changes of behavior, in changes of attitude, in changes of personality, and in their leaving the teaching profession.

Eight perceived problems of beginning teachers in general are discipline, motivating students, dealing with individual differences, assessing students' work, relationships with parents, organization of class work, insufficient or inadequate teaching materials, and dealing with problems of individual students. Wanting to go beyond a listing of problems, Veenman suggested three frameworks that can be used to examine such teacher difficulties: a developmental stages framework, a cognitive development framework, and a teacher socialization framework. Those ways of viewing the development of new teachers all attempt to explain individual changes and are complementary. Together they give a more complete picture of the needs of beginning teachers and lead to possible programs and plans for support of those in their induction years.

Problems of Beginning Teachers. Ryan (1986) suggested six common problems experienced by new teachers: with the "shock of the familiar," with students, with parents, with administrators, with fellow teachers, and with instruction. The "shock of the familiar" characterizes the adjustment that must be made by people who have been students for years but are now facing the multiple demands and responsibilities that accompany their new role as teacher, not student, in the classroom. Problems with students are of (at least) three types: understanding students and their needs, establishing an appropriate "social distance" from students, and discipline. Discipline problems arise because beginning teachers have

a "highly romantic view of students" (p. 20), because of their own "quest for approval" (p. 21), and because of their inexperience and lack of skill.

Problems with parents may have several sources including teacher inexperience leading to parent apprehension, parent jealousy, and a teacher's lack of understanding of the pressures of parents' lives. They may be based in part on the fact that "teachers in training do not think about parents very much" (p. 22). Problems with administrators may be caused by the different roles and perspectives of administrators as well as on teacher problems with authority. Problems with fellow teachers may arise because of jealousies and "turf" protection, from social differences in a faculty group, and because a "new teacher will change the status system and reward structure of the school" (p. 27). They may well be a function of the fact that teaching is a high stress job, the demands and pressures are many, and interpersonal relations often suffer as a result.

Consequences of Problems of New Teachers. Ryan (1986) dealt quite specifically with the costs of difficulties of beginning teachers for many in the educational community. He emphasized the negative effect on student learning that is a consequence of a new teacher's struggles. He mentioned the problems for parents who are striving to protect their child's best interests and for administrators who must deal with both the consequences on student learning and parental concerns. Administrators must also be involved when discipline breaks down in a new teacher's classroom both in dealing with individuals and in advising the teacher on ways to restore order.

In addition to consequences of beginning teacher difficulties for others, there are costs for the individual teacher. The so-called "curve of disenchantment" (Ryan, 1986, p. 8) can, and often does, lead teachers to leave the profession.

## Research Strategies

Methodology. Since this study involved an in-depth examination of phenomena, we used the qualitative case study strategy. This case study traces the teaching/learning experiences of the participants throughout their first years of teaching. As recommended by Page (1991) and McGinnis & Simmons (1999) the analysis of the data was particularly sensitive to the participants' perspective of each of the school's culture or meaning system.

Data Collection and Analysis. Data sources include individual and focus group participant interviews (recorded and transcribed), analysis of classroom teaching practices (videotaped), student and teacher journal reflections, and interviews with the participants' principals (recorded and transcribed). See Tables 1-8. These data were informed by a previous four-year extensive data collection period of the five participants as they proceeded through their undergraduate reform-based teacher preparation program.

We collected and analyzed the data through the use of the qualitative technique of analytic induction to construct patterns of similarities and differences between the participants (Bogdan & Biklen, 1992; LeCompte, Millroy, & Preissle, 1992). This procedure involved careful reading of all textual data (e.g., interview transcripts and observation field notes) to develop a more global perspective of the data. For this paper, three researchers examined the data and came to consensus conclusions. Disputes were negotiated by appeal to evidence in the data collection. Exemplar participant quotes were selected to illustrate our findings and assertions.

While data interpretation is involved in every stage of the research study, it became more clearly the focus of the work once we had organized and synthesized the data. At this point in the analysis, we began to put more effort into thinking about the implications of the data. In other words, we asked, "What does this focus on new mathematics and science teachers mean for the preparation, practice, and retention of individual reform-minded teachers in specific settings?" Initially a review of our data led us to believe that the new teachers held similar views on teaching, all in support of reform-based practices. It became apparent over time, however, that there was drift from these initial beliefs that impacted their practices and long term career plans. The variable that struck us as the most significant was the different school cultures into which the new teachers were becoming socialized. Therefore, after first attempting to analyze the data with time as the organizing tenet and combining all participant data, we found it more informative to return to the data and analyze by individual participant over time. This differentiation of our data analysis led us to recognize that while it is important to prepare *all* new teachers to enact reform-based practices, to understand the process of socialization of new teachers in different school cultures it is essential to conceive the process as an *individual* passage in unique workplaces. The socialization framework as



proposed by Veenman (1984) with its two component framework (the individual's needs, capabilities, and intentions, and the institutional demands, supports and constraints) assisted us in presenting our insights in manner that recognized the individual strands while weaving them together to represent a common process.

**Participants and Research Sites.** First year: 4 women, 1 man; 1 Asian-American, 4 Whites; 1 non-traditional in age; 3 with upper elementary teaching positions, 2 with middle level positions-1 in mathematics, 1 mathematics/science. The five participants taught in 3 elementary and 2 middle schools. Second year: 3 women, 1 Asian American, 2 Whites; 2 with upper elementary teaching positions, 1 with middle level positions-mathematics/science). The continuing three study participants taught in 2 elementary and 1 middle school. See Tables 9 and 10 for a complete presentation of the school demographics and student criterion examination results. What follows is a brief description of each participant and school context (pseudonyms used in all cases).

*Ms. Susan Lee* is an Asian American woman, a traditional college student, finishing her degree in four years. She participated in one summer MCTP research internship at a space and aeronautical lab. Ms. Susan Lee taught fourth grade at Overlook Elementary School. Overlook Elementary School had not met any of the local standards on the district's criterion referenced tests. The school was attended by 42.2% Hispanics, 28.5% African Americans, 21.2% Whites, and 7.6% Asian. Sixty-two point two percent of the students received free or reduced meals. The school's mobility rate was 24.1%.

*Mrs. Laura Kern* is a White woman, a non-traditional college student who attended and transferred from numerous colleges and universities as she completed her undergraduate education degree. She completed her four-year degree in her mid-twenties. Mrs. Kern completed a summer MCTP research internship at an oceanside environmental education center run by the National Park Service. Mrs. Kern developed curriculum and ran daily programs for the park. Mrs. Kern transferred schools after her first year to accommodate the far away location of a newly purchased home. The school where she taught third grade her first year was Rock Hill Elementary. The school was over half African American (55%) and almost a quarter Hispanic (24.2%). Asian students and white students made up 8.5% and 11.9% of the population respectively. Over half of the students (59.5%) received free or reduced meals. The school had a 37.4% mobility rate, which was the highest of the six schools where our five participants were employed. The school had not met any of the district's grade appropriate criterion referenced test standards. Mrs. Kern taught fifth grade at her second school, Rider Elementary. That school also had not met any of the district's grade appropriate criterion referenced test standards. The school's population was 53.1% White, 21.6% African American, 16.7% Asian, and 8.7% Hispanic. Twenty-four percent of the population received free or reduced meals.

*Ms. Katie Phillips* is a White woman, a traditional college student who finished her undergraduate degree in four years. She participated in one summer MCTP research internship at a science curriculum writing organization coordinated through the county where she is presently employed. The summer after her internship experience, she was employed by the organization as a curriculum writer. Ms. Phillips was employed at East View Middle School to teach both eighth grade mathematics and science. East View's population was composed of 64.9% white, 14.1% African American, 13.9% Hispanic and 6.9% Asian. Seventeen point one percent of the population received free or reduced meals. The school met four of the six standards for the district's criterion referenced tests. The students had not met the standards in sixth and eighth grade math.

*Mr. Mark Jones* is a White man, a non-traditional college student who returned to the University to complete his undergraduate education career after spending his early twenties working in the business world. He did not participate in a summer MCTP research internship (he was excused by the MCTP program due to his exceptional need to earn a summer salary for his family). Lincoln Middle School employed Mr. Jones for the first year of the study. Mr. Jones worked one year teaching eighth grade mathematics at Lincoln Middle School. After he completed his first year, he moved out of state to an American Indian Reservation where he is presently teaching science and serving as a school administrator. Of Lincoln's 6-8 graders, 38.3% were White, 30% were African-American, 20.6% were Hispanic, and 11.4% were Asian. Almost a third of the students (30.2%) received free or reduced lunches. The school failed to meet the local standard on the district's criterion reference test except for the sixth grade reading tests in which 76% of the students met the standard.



*Ms. Mary McDonald* is a White woman, traditional college student who finished her degree in four years. She participated in one summer MCTP research internship at an informal education curriculum development organization. She is presently teaching her second year at Glen Oaks Elementary School. Ms. McDonald taught fourth grade both years at the most affluent school site in our study, Glen Oak. Only 6.6% of the students received free or reduced meals. The school's population was 62.5% White, 29.1% Asian, and 5.9% African American and 2.3% Hispanic. The school's population had the lowest mobility rate of the study's six schools, (9.8%). The school also had met all the local standards with the exception of fourth grade mathematics on the district's criterion referenced tests.

## Findings

Our findings are presented initially as select participant responses to our research questions. We believe that this strategy demonstrates respect for our participants (allowing their voices to be preeminent) and enhances the study's credibility. We provide a second level of analysis in our Discussion Section. These data representation strategies acknowledge the power of the emic voice (the participants' inside perspective) to provide the reader a better understanding of how the participants tell the stories of their professional lives (Van Maanen, 1995). In addition, the etic (the outside perspective) provides the reader a wider perspective of how the participants were perceived by others as they practiced in particular school cultures. The etic perspective in this analysis is composed of vignettes of participant lessons, the participants' students' comments on lessons, the participants' principal voices, and the researchers' theoretical framework on the data.

### Question 1

To answer our first research question ("As they proceed through their induction years, how do new specialist teachers of mathematics and science who graduate from an inquiry-based, standards-guided innovative undergraduate teacher preparation (a) enact their roles as teachers; and, (b) think about what they do when teaching science and mathematics with upper elementary/middle level students?") we analyzed data collected from the individual and group audiotaped and transcribed interviews, videotaped classroom lessons, participant reflective writings, student reflections, and classroom artifacts.

**Inside Perspective.** The participants' individual and focus interviews conducted over two school years were the data sources for the participants' view of how they enacted the role of a reform-prepared teacher and what they thought about while teaching content in their school contexts. We found it informative to report the data by participant, identifying the time (first year fall, first year spring, and second year fall) to document if changes in the participants' perspectives occurred over the study period.

### Ms. Susan Lee

a.) Enact her role as a teacher.

#### **Fall 98**

I'm teaching an upper level math, a high group, and I'm using a lot of the activities that we did, the hands-on, constructivist activities that we learned in our courses, especially in the methods. I'm using a lot of those activities from my MCTP science methods professor because it goes along very nicely with the hands-on, constructivist deals, and the kids are doing great with it. They look forward to coming to math and science, and also I'm integrating the math and science activities in with the other subjects, too, like the writing activities, and so it actually is an integration of all subjects, but it's working out very nicely. We just finished a unit with a lot of hands-on activities, and actually I had the students work in groups, and I floated around the classroom and informally assessed them, like, their kind of discussion in the groups and then the whole class discussion, the kinds of questions they had and the kinds of information that they wanted to share, and that's one way that I assessed them....I notice that my teaching is a lot different from the ones at the school. Most of my strategies are better. They have one other new teacher, but everyone else has been teaching more than five, ten, fifteen, maybe even thirty years, and I guess it's different in that for all of them there is more direct instruction, and more of, like, a lecture type, and there is a little bit of hands-on....I think that the way that I'm teaching the kids really, really enjoy coming to class because they actually get to formulate their own ideas, and they get to problem-solve. My instruction is different in that I don't do as much direct instruction. Every now and then I have to a direct instruction lesson, of course. I can't only do the constructivist, otherwise, they won't get quite so much accomplished.

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### Spring 99

We are doing some research on ecosystems, using guppies. I send the kids to the computer lab right across the hall to do research on the Internet. It is definitely a big part of our learning. My students are constantly building upon the things that we have learned. I mean there is a purpose for it. I ask my students, "Why do you think we're learning about this?" And they are able to say, "Well, we're learning about this because...." For assessment, in math I keep a journal. In science we've done a lot of hands on things and discussions and they have been keeping a journal. That is how I have been grading them—group participation lab and things like that. In math and science I've stepped away from the formal assessment.

- b. Think about what she does when teaching science and mathematics with upper elementary/middle level students.

### Fall 98

If I'm doing a lesson in math, I'll make connections with my science lesson. I do more of the math and science connections, but sometimes I do it through comprehension activities, reports, and things like that. I mean, that's how you can integrate with other subjects, but in terms of math and science, they do go hand in hand.

### Spring 99

I teach math and science in a completely constructivist approach. I do use some directed instruction, but I do encourage a lot of cooperative learning and letting the children figure things out rather than me telling them everything. We use manipulatives, learning stations, where they formulate ideas on their own. It's more independent. Right now, we are doing an ecosystems unit and we're making aquariums. They get to have guppies and pond snails. We are actually making a mini-environment in ecocolumns. I mean basically, I model everything I do after what I learned in the MCTP. When I'm teaching a science unit I tie in the science with the mathematics. And when my students do science, they know it's not just science, we're also doing mathematics. When we are doing mathematics, we do have reading, writing and science, too.

### Fall 99

I'm noticing that the children have a tendency to remember things a lot more with these hands-on lessons rather than just reading it from a text book. I remember at the beginning of the school year, I did a lesson on chromatography. And that is a third grade objective and I asked. I said, "Most of you should have, this is a review for all of you, who were here last year. I know you did chromatography". And then I said, "What is this?" And I had no hands. No one raised their hand and I couldn't believe it because if you're thinking of colors. I mean, it's something that would sit in my mind. You know, because I mean you're seeing the color strip and splitting the colors, I mean, as a hands-on type thing. And I don't know how it was taught but they didn't remember that. And I did a whole lesson and they're like, "Wow. This is so cool, we've never seen this before." And I'm like, "Well, I'm doing it in a hands-on type way and I'm hoping that", you know, I'll ask them again at the end of the year if they remember, and I'm hoping so that they will because, apparently, the way that, well, I know who the science teacher was last year, and she is more so by the book. And she's not, she does do some activities and things like that. But I'm seeing that the MCTP way, being constructed this way, has been really benefiting the children here. So, that's just one example. In their performance, I'm noticing that they're remembering a lot more. And they're, I asked them – I don't know, you'll see today, I asked them to review what they've done in the previous activity. And they're able to do that and they remember the last time they had science. And like, "Oh, we did this, we poured vinegar and calcite together to see if there was a reaction." And they can remember that, so that's been helpful.

During today's lesson I taught money concepts, which is obviously a mathematics subject area. There was some money exchange and there was addition, subtraction, and multiplication problems. Those were all in word problem form. So there is more of an application, problem solving situation..... Well what I did is I elicited prior knowledge and I wanted to see how much they actually remembered with money exchanges and just the whole concept and idea of money. They were very enthusiastic about it, I saw. And they remembered a lot from previous teachings.

After that, I put them in cooperative groups and they worked together to solve problems, use critical thinking skills, and they used each other's ideas and encouragement and everything to solve problems. And so it was very problem-solving oriented and it was hands-on....What I do notice is that the more and more experience I get, how much easier it is for me. And I think because I have that solid foundation already, it's just really helped my teaching. But now it just comes much easier to me because I have been taught in the constructivist way. You know, this whole idea of teaching. And it's just something I can't forget, I don't forget anything that I've learned in the courses that I took because it's been very helpful to me.

#### **Fall 99**

In my classroom I've been teaching a lot of mathematics and science in an integrated lessons. The one thing I did not know was how involved they were in terms of setting up and all the materials that you needed. I found myself having to spend many hours in preparation for each science lab. And I just, I mean, I've gotten materials from books and curriculum guides and, you know, I've been creating my own lessons but I never knew the extent to which every little detail, every little piece of material, it matters. Like when you take it out or when you introduce it to the kids. Because if you put it the wrong time, the whole lesson could fall apart. So, that's like one of the big things now that I'm working on. Making sure that everything that all the materials and all the hands-on manipulatives and those type things are put out in a timely fashion....The way that I teach is more that they're building the knowledge, so it's not just memorizing facts, and it's like...I guess it's like some kind of stairs, you know, like if you build on top...one on top of the other, you know. Everything is connected, and so they never question why they're learning something, and they always are, like, "Oh, this builds on top of what we learned yesterday." And so in terms of understanding, I think that this approach is just so much better. I'm very pleased with the results that I am getting in the classroom.

#### Mrs. Laura Kern

##### a.) Enact her role as a teacher.

#### **Fall 98**

Everything else I have done includes lots of really neat projects. Our team has been coming up with monthly enrichment projects. The first one was a family history kind of using math skills, and a family tree, and a glyph kind of data representation, and that was like the getting to know you one for the beginning of the year. Then in October we were kind of enriching the plant growth development unit, so they had to research a specific plant, create some kind of model or diagram or diorama, also maybe something creative like write a poem or draw a picture or write a song about a plant. So more like project oriented.

#### **Spring 99**

We have a real push in this school for differentiating math, because we don't switch for math, so I have real, real low kids and real, real, real high kids ability level and our principal is around every single day, so we are pretty much forced to have two or three kinds of activities going on at once within an hour period. So I've felt pretty comfortable about that because of the Collaborative, but I know that it's a real frustration for a lot of teachers and at all the team meetings when like the math specialist comes or we have just other resource specialists in the building that do math and language arts and everything else, when they come and offer help, everyone is asking for help with how do we differentiate math?

##### b. Think about what she does when teaching science and mathematics with upper elementary/middle level students.

#### **Fall 98**

One of the things that both of my official observers (the principal and the vice principal) said was that they had never before seen at my level of performance, was the use of higher level thinking and questioning. It was a real surprise for them to see that in a first grade teacher. And it's not something that I even feel like I'm trying to do. I'm not always thinking, "Okay, let me think of a higher level of question," but I think it's for being in all, like, my MCTP science methods professor's courses and things like that where that's where they questioned us, and I just kind of

picked it up, you know? So that's one really great thing I picked up from MCTP to use even without knowing and realizing....The only way the other teachers know to teach is by the work sheets. But in my class we talk a lot. The big thing that I've been doing now is with journaling, explain how you found your answer thing. "This is how I got my answer. First, I...." you know, and there's like two lines where they describe what they did. "Second, I did this," just so that they're kind of thinking about what and why they're doing what they're doing. And so I feel like we do a lot more writing and talking about math than I've seen in two of the other teachers' classes.

### **Spring 99**

I think I came into teaching with a much stronger background and I'm stronger at developing lessons, and I think it has more to do with the Collaborative than anything. Because there are several new teachers here at my school and every person that has talked with me has said that I kind of am better established for a first year teacher. I have no other thing to pay tribute to it except the Collaborative. I think I always try and plan lessons that go for concept and process not product. A lot of my main problem was with this instructional objective outcomes testing for my county's math curriculum. This is the way they do it. My main problem with that is they really kind of hurry you through it, even maybe if it's not time and you know, I kind of in the beginning I was really kind of worried about getting into trouble and not you know you're supposed to cover eight objectives per quarter, and thinking when I only had six done and a week to go, could I cram in two objectives in a week and was trying to do it. I think now I'm kind of thinking more about what's better for the kids and okay if we just don't get to that one by the end of the year that's okay, but I'm not going to rush through common fractions just so I can meet that goal.

### **Fall 99**

In today's lesson the math content I guess is constructing geometric solids and kind of reinforce some of the vocabulary we learned last week, edges, faces, vertices, base, polygon. A little bit later they'll apply it and write procedural writing. Oh, and one of the questions is: "Why couldn't we do a cylinder or a cone?" And I asked them to design an activity where they could make a cylinder or cone. So they'd have to come up with some kind of either string or pipe cleaners that could be bent into curves. So, that's kind of an extension of it. I gave them things to work with and opportunities to build different types, with teaching for understanding. What the warm-up, I was kind of surprised, they – normally several of them get it. But today, none of them got it. At all. And I don't even know after going over it, if I had 100%. And the thing is, we about three weeks did one that was really similar to that. Like different settings but real similar. I was really surprised at that. But I guess a few of them I know for sure got it towards the end. But, you know, how much time do you give up of your class time for teaching for understanding? I guess working with a partner or anyone at their table, working with manipulatives, having a three-dimensional model instead of a picture from a book to look at, to understand what all the terms were. A couple of them mentioned - with making connections between math and science – "Can I add some triangular support?" Because we talked about how triangles add additional support when we're building structures. And I probably could have made more of a link to the science curriculum, but I didn't. But when the few did say that, you know, I kind of reinforced that and talked with them about it. But I guess I could have done a little bit more leg work and integrated it more. But I didn't want to take away from the geometric solids and cause any kind of lack of understanding with them.

Ms. Katie Phillips.

a.) Enact her role as a teacher.

### **Fall 98**

I teach both mathematics and science and my students get mad at me because the kids sometimes ask, "Why are you teaching us science in math class?" That's because you're a science teacher and you want us to do science. Because you like science more than math. Or, in science class sometimes we'll use math. The other day we were working, because we're starting on weather right now, and we were working on converting Fahrenheit to Celsius and Celsius to Fahrenheit.



And, you know, many of my students said, "This is math, why are we doing math formulas in science?" And so I do, I do use math in science and science in math all the time.

My first two months of teaching really killed me. I wanted so badly to incorporate all of the strategies that I had learned through MCTP. I really wanted all of my lessons to be hands-on and meaningful. I tried to incorporate math into science lessons, and science into math lessons, so much that my students would often say, "This isn't science class, this is math class," or vice versa. I also wanted to incorporate technology into my lessons, but dragging six computers into a classroom where you will only teach one period just didn't seem like an efficient use of time. Taking a class to the library to use the computers was virtually impossible, because teachers sign up for the lab six months in advance and then stay there for two or more weeks at a time. I would get to school at 7am and often stay until 7pm planning lessons, gathering materials, writing e-mails to parents, and grading. All the while, seeing other teachers leaving the building as soon as the afternoon bell rang. It didn't take long before all of this began to seem very unfair. Here I was, the newest teacher at the school, with the hardest schedule, and no one wanted to help me. I will be honest in saying that Life Science was not my priority. I usually made my plans for Life Science after I had already planned for everything else and by that time worksheets and book reading seemed like a pretty good idea. I did feel bad for the kids in the class, because I knew that I wasn't a very good Life Science teacher. I know that I will have many of them again this coming year in Earth Science, and I will make it up to them.

### **Spring 99**

I can say that I was fortunate to teach Earth Science with two great teachers. The three of us had to plan lessons together because we shared classrooms. Luckily we had very similar ideas about teaching. We developed a lot of lab experiences, and performance assessments. The students probably hated us because we made them write so much. We stressed the scientific method, and required the students to do formal lab write-ups of many of the labs that they did in class. Weekly journal assignments were mandatory in my class. Sometimes I would assign the students a topic to write about, and other times I would let them write about an Earth Science topic of their choice. I found that journals were really a great way to differentiate learning. Some students would write a paragraph about the weather that week, and others would do research on the Internet and turn in three pages, in great detail, about what they had learned. This really helped me to understand the individual students and their abilities, and I learned a lot from reading the journals. I never graded the journals; I only gave credit for completeness, and wrote comments to the students.

### **Fall 99**

In my county, students have to take [instructional outcomes tests]. These are short quizzes that must be passed after each new concept is taught. They are never ending. At the beginning of the year I received reports on each of my students showing their progress on the [instructional outcomes tests]. Not surprisingly, about 90% of my students were below grade level. In many cases, because their seventh grade teachers never gave the required [instructional outcomes tests]. As an eighth grade teacher, it was my responsibility to get them on grade level before they went off to high school. The [instructional outcomes tests] became a major focus in my classroom. The [instructional outcomes] objectives became my classroom objectives, and the [instructional outcomes tests] became my quizzes.

The [instructional outcomes tests] were a daunting task, but I tried not to let them dictate everything that I did in math class. One learning strategy that I thought worked really well was the use of round the clock learning buddies. The students got a worksheet with a picture of a clock, and they had to make appointments with a different person for each hour. They kept this sheet in their notebook for the entire year. I would say, "Meet with your 4 o'clock buddy," and the students would move and work with that person. This gave them some choice in selecting partners, but it also assured that they learned to work with lots of different people, and the shy kids always had someone to work with.

I assigned projects each quarter in math class, and I tried to do a lot of hands on work that incorporated science. Sometimes we would do experiments to generate and analyze data for relationships between variables. We went outside to measure shadows and related this to the height

of tall objects during a unit on similar triangles and indirect measure. Students created tessellation artwork, and studied M.C. Escher in our geometry unit. During the probability unit we played a lot of games, and students worked in groups on a probability scavenger hunt for which they had to find items from school, home, and the community that related to probability. Sometimes I did resort to worksheets, but in all I was very happy with what we accomplished in Math 8+....Life Science is not a subject that I want to spend much time writing about. Worksheets were common, as were textbooks. We did complete quite a few prepared lab packets, and the students created hyper studio presentations on endangered species. The trip to the National Zoo was probably the high point of the year in Life Science.

Today's [science] lesson was hands-on. They got to do the experiment on their own. The only thing I had to do was measure out the guar gum for them. I wanted it to work so I did that. I guess letting them, they did get to measure the volume in the water. They did have to calibrate the scale on their own and get it set up to be measured. So, they were working with the scale. The only thing I did was come with the spoon and dump the chemicals on because the guar gum is actually really expensive. So if that gets a lot of it, even I was dumping it all over the place because it flows around. So, if they had done it, it would have I think been really a disaster. And also I guess, not going into a bunch of definitions of what, I didn't tell them what they were going to make before they made it. It was like a mystery to them what it was going to be. And in the end, they came up with a product and then after that, they have to go back and look at what they did and look at what it was they made and answer some questions *afterward* about what they think it was. So, not telling them ahead of time what they were going to do and what they were going to make. I did introduce the vocabulary word, polymer, but I didn't tell them what it was. So that was one thing. Letting them see what it was before telling them what it was. This was the very first time ever that they have gone on and used the scales at all. And just kind of letting them go and figure it out a little bit for themselves before. I didn't sit up with the scale in front of the room and say, "Here's how you measure this" and "Here's how you measure this, here's how you measure this". I just kind of let them go with it and kind of figure it out. And I did see that some of them had already probably had experience with them and were helping the ones that didn't. Some of them were able to get it done a lot more quickly. And the kids that finished early, I asked to go around and help the other kids. I don't know if they actually worked, because I think they were too involved in playing with their slime, but trying to do that. Trying to get the kids to work together in groups. And they were working in pairs, but they really ended up working more than just in pairs because they were all helping each other in the area where they were.

In today's [mathematics] lesson, the math content that I taught was inequalities using spaghetti and breaking spaghetti into three pieces to either form a triangle or not form a triangle, and then had the kids come up with inequalities for the length of the sides – so it is a math concept not really a science concept. I think by actually having them physically break apart the spaghetti pieces and being able to hold them together and look at the length and so it was like hands-on sort of thing, coming up with a hands-on inequality. Also, I had them come up, well I had to lead this class a little bit, but trying to have them come up with the inequality on their own, rather than telling them. It would have been very quick just to give them a rule, like any two lengths of a triangle are always greater than the length of the third side. That could have been something that I could have them copy down right away and just go on from there and not let them actually look at it. But we've been working with other inequalities for a while. We have just started with inequalities for a little under a week, and I think some of them were having a little bit of a hard time understanding them. So I thought it would be a good idea for them to visually and physically be able to look at what an inequality is.

**b.** Think about what she does when teaching science and mathematics with upper elementary/middle level students.

**Fall 98**

A lot of the time I will use math in science, or I will use science experiments and things to teach math concepts in science....I use rubrics a lot. I kind of base them sometimes on the ones that my MCTP science methods professor would do in glass to grade things. Rubrics, I have the kids right journals every week. In earth science they have a journal due. Either I give them a topic, or they have to do a free write about anything in earth science, so those are two things that I think I kept from MCTP, things that I like to use. In math the way I teach, I think, is very different from the other math teachers, because they've been in the school system for a long time, and they're older, and they do a lot just, "Here's a work sheet," and "Here is how you do it. Do this, do this, and do this." And I try to fuse the science and use hands-on sorts of things in math, also, so I mean I'm way off, I think, in what I'm doing. And in pre-algebra I think it's quite a bit different than them. ....I count a lot of things as tests and quizzes if I do a project or something; they're not really test quizzes, so I like to use more projects and things like that and just give small quizzes than giving these big unit tests that the other teachers give.

**Spring 99**

I do try and stress teaching by understanding. I think that one of the things I like to do is find out what kids know ahead of going into a new unit about something and then kind of going from there. And also, teaching through labs and things. I think that some of the things that we do in our science are better sorts of labs for understanding. Where the kids actually go through and set up a lab and do some sort of an experiment rather than just looking at things under slides. And I guess that that is a big part of biology is looking at the amoebas and things like that.

Mr. Mark Jones.

a.) Enact his role as a teacher.

**Fall 98**

The one thing I did was not necessarily to introduce the problem, and I think a lot of MCTP was like that--getting people wanting to figure it out. I did something toward the end of the year on a Venn diagram that was more of a group activity, a social activity, where people worked with each other or work as a whole group. We went outside, and I got shaving cream, and I made three huge circles, intersecting circles. A Venn diagram. Then I asked different questions, such as, "If you have a brother stand in this circle, and if you have a sister, stand in this circle, and if you have a pet, stand in this circle? And they started, "Well, you have a brother." "Well, he can be over here, because you have a sister." It was pretty interesting. Other instructions I gave were, "Do you like hamburgers? Stand in this circle." "Do you like spaghetti? Stand here" and things like that. And then once they were in the different circles, after they made their decisions and they argued and talked, then they would do A intersecting B, and then they were supposed to, if they were in that section, those people should stand, and the rest should kneel. It was sort of hands-on (body-on!) activity that would hopefully help kids make a more concrete connection to the Venn diagram which is sometimes a little abstract.

b. Think about what he does when teaching science and mathematics with upper elementary/middle level students.

**Spring 99**

My MCTP preparation has impacted my teaching in math (the only subject I teach). I think it's certainly directed the way I'm trying to teach and getting more into teaching this way with a lot of discovery-type activities, learning, I do group work, cooperative work. I'm doing a lot of, or trying to do more and more, for the lack of a better word, you know, [performance-based]-type of activities. More process sort of, not testing, not evaluating the process, but maybe discovery through process and I've been trying to make activities where students need to read through some specific directions and it's got, you know, and they'll have this is what you do next and then do this. They need to read through and then answer questions, do research, and hopefully come up with some answers on their own, some formulas, or whatever we're working on their own or in their groups rather than me just lecturing just lecturing to them and saying "Okay, now do 10 more of these just like it or solve these problems." I still do that, and I still have them do homework or

lab work where they're doing some, I don't know if you call it drill and practice but I feel like the program has influenced the way I'm teaching quite a bit. I feel like I have been getting my feet solidly on the ground, so I can come up with activities or, you know, have the time to even develop them or implement them or use them... The textbook I use mostly for homework type assignments. I do most of the instruction through what I come up with using manipulatives. I have more class activities than the other teachers. They use the textbook.

I definitely teach for understanding. I believe I am anyway, and I feel like I'm sort of handcuffed in way because of [instructional outcomes] in the County, I'm limited and probably shouldn't cover subjects to the depth that I do because I should be moving on to the next objective which I feel, I feel I have teachable moments sometimes I set up in my process and I hate to just say "Okay, we've got to stop now and move on to something else."

Ms. Mary McDonald.

b. Think about what she does when teaching science and mathematics with upper elementary/middle level students.

### **Fall 98**

I think that I tend to focus more on the MCTP way of teaching math; whereas, a lot of the teachers are still doing the old, you know, worksheet answer it, turn it in system. I would say I teach in a more constructivist, problem approach where the students are working on some kind of major idea, but they're kind of constructing their own knowledge just through different experiences that they have. I use a lot of manipulatives and that kind of thing. For example, I spent two whole days on teaching the students why we multiply; they had no idea. They've always just been told this is what you do. You just multiply, but they really had no idea why we needed to do something like that, so I think that's gonna help them to be able to...to be better multipliers if they understand where that's coming from and why...and in what, you know, instances that it works in their lives. Whereas, they're not getting that in a lot of the other classes, and I think MCTP helped me to be able to do that, because I certainly wasn't taught that way [as a young learner]. But then again, I think that I cover a little bit less. The more veteran teachers can get through a lot more material than I can get through so, I mean, I think you have to kind of decide, you know, whether you want to just leave stuff out, or if you want to skip a lot of the information, but we try to combine a lot of it so that, you know, it's going on at the same time.

### **Spring 99**

I think I'm a little bit more confident in teaching math and science than other teachers, other new teachers, and even other, you know, current teachers. The MCTP gave me a lot more experience and ideas, I think, to draw from. I think that I am able to come up with different ways of seeing of assessing the kids. We do a lot of discussion type things. I write a lot of notes when they're speaking to me. Usually at my school, teachers rely on your usual written, fill-in the blank space, and circle the answer kind of tests. I do a lot more activities or team work or some kind of an activity that draws out their knowledge. I have them assess themselves all the time....A lot of teachers don't teach the science because it's not required, I mean it is technically, but you would never know if someone did not teach it. For example, one of my teammates and I had a whole unit on sound. There were 15 or 16 lessons. She got through the first two while I taught them all. I build a lot more math and science time into my schedule than the other teachers do. Just because I want to make sure they the students get those subjects. I also give the kids more independent group work, where they are on their own, doing their own investigation. A lot more of the teachers rely on taking the students on a step-by-step lesson, almost kind of giving them the answers as they go along.

**Outside Perspective.** The primary data sources of the outsider perspective of how the participants enacted their roles as reform-prepared teachers were videotaped observations of the participant lessons and elementary/middle school student comments of their teacher's mathematics and/or science teaching



practices (when available). We found it informative to report the data by participant, identifying the time (first year fall, first year spring, and second year fall) to illustrate the participants' teaching over time.

### Ms. Susan Lee

#### *Fall 1998 Vignette.*

Ms. Lee introduces the lesson by saying that there is something special going on the entire month. Student's hands go up and a student offers "Asian Pacific Heritage Month. Ms. Lee responds "that's right, Asian Pacific Heritage month." I am very excited to bring something from my culture, from China, to the classroom during science time." "We have been studying ecosystems." "Can someone remember what you need to grow a plant? The class begins listing things that are needed to grow a plant: soil, water, air, the right temperature, light, etc. Ms. Lee writes the students' answers on the chalkboard. The students are eager to give answers; they almost all have their hands up.

Ms. Lee states, "you are going to plant something special, it is called the Dow Gawk." Can everyone say that? Ms. Lee writes the word on the board and states, "this is also called the Chinese Long Bean." "Let me tell you a little about the Chinese Long Bean before, everyone in here is going to plant their own Dow Gawk." "Something special about this Dow Gawk which is similar to the string beans that we eat. What does the string bean look like?" Students share responses such as it is long, it is nasty, it looks like a pod, etc." Mrs. Lee praises the students' answers and continues to tell the students about the Dow Gawk. She tells them how large the bean gets, to a size "most people would not expect." She tells the students that she won't tell them how large the plant will get, but that the plant will grow out of the cups that they will plant the seed in and that they will have to plant the plant into a larger pot. "And eventually you'll have to grow it hanging because it won't grow straight, so, I will need a couple of volunteers." Hands shoot up.

Ms. Lee passes out the seeds and asks the students to observe the beans and write down their observations on an index card. She asks for a student volunteer to pass out the index cards. While Ms. Lee places a bean on each student's desk, she says, "There is something else about this bean so I want to look at it and think about ways to describe it." Students attentively study the passed out beans. Ms. Lee states, "So you should be describing your bean on the index card, write a sentence or two describing the bean." Ms. Lee asks for volunteers to share their observations. Students share their observations such as the size of the bean, the color, and the texture. Ms. Lee praises the students for their observations.

We will be planting these Dow Gawk seeds today and charting their growth until the last day of school. You are welcome to continue the growth in the summertime also." A student asks if you can eat the beans. Ms. Lee replies yes, you can eat them or you could replant them. Ms. Lee shares with the class that her mother plants them in her vegetable garden. She tells the students that if they take care of their plants, the plants will grow very large, larger than they expect." The students begin to ask how large the beans will get. Ms. Lee replies "you will find out."

Ms. Lee shows the class some graph paper and tells the class that they will be charting and graphing, every other day the beans growth. Next, Ms. Lee points out to the class that the beans are wet and asks the class why. One boy offers that soaking the beans speeds up the growth. Ms. Lee praises the boy for this answer and tells the class that yes, soaking the beans before the class plants them will speed up their growth.

Ms. Lee asks for a volunteer from each table to come and retrieve supplies. Hands shoot up. A volunteer from each table retrieves supplies for each table.

Ms. Lee asks the students to observe the cup in which the beans will be planted. One student points out that there is a hole in the bottom. Ms. Lee asks, "why do you think I put holes in the bottom?" A student offers "So if you add too much water the cup won't flood." Does anyone want to add anything? Another student offers that the hole could make it easier for them to observe the plant root system. Ms. Lee shares with the class that the main reason for the hole in the bottom of the cup is to allow excess water to seep out, "because if you over water these beans they will not grow."

Ms. Lee asks the students how far down they should plant their seeds. A student suggests that if they plant the seeds too far down, the plant won't be able to reach the top. The students plant their seeds. She instructs the students to put their index cards underneath the cup of seeds and place the cups in the tray at the center of the table.

Ms. Lee hands out graph paper to the class and tells the class that they will begin the graph today. She states, "you will be doing a line graph, we have done this in math class." She asks the class "ht are the types of things you need for a line graph." Students raise their hands and one boy offers that the graph needs a title. Ms. Lee asks the class, what would be a good title for this graph? I student offers Dow Gawk. Another student offers "Planting a Dow Gawk." Ms. Lee passes out rulers. Ms: Lee asks, "tell me something else you need to make a line graph." A student suggests lines. Another student suggests numbers. A third student suggests labels. Ms. Lee writes all of the students' suggestions on the board. She tells the students that the vertical axis should be "measurement in centimeters. The students label their graph. Next she asks, "On the bottom axis what should you put? We will be measuring the growth every-other-day, that is a huge hint. Several student hands shoot up. "SO what should we put on the horizontal axis?" A student offers, "days."

Ms. Lee walks around the room checking students' graphs. "A reminder, the days are on the bottom axis, the horizontal axis, the axis that is lying flat. And the measurement is on the vertical axis, the one that is going up and down."

The students finish preparing their graphs for charting their plants growth and clean up.

#### *Fourth Grade Student Comments (Fall 1998)*

- She helped us learn science by teaching us how to observe rocks more carefully. She also helped us understand why rocks change.
- In class we use computers on what we do or need help with.
- When we poured the vinegar in he evaporation dish we used math to measure half of the dish. When we observed the rocks, we used science.

#### *Fall 1999 Vignette.*

Ms. Lee begins the lesson with an introduction and warm-up on the overhead projector. The warm-up is a problem about money equivalents: List some ways that you can use coins to pay for a candy bar that costs a dollar. The class offers responses like: 4 quarters, 10 times, 100 pennies, 95 pennies and a nickel, 2 quarters and 5 dimes, 20 nickels, 5 dimes and 50 pennies, 5 dimes and 2 quarters, etc. Ms. Lee praises the class by saying, "I am very pleased, you guys remember a lot." Next, she asks, "Why is being able to use money important?" The students respond with their reasons for the importance of money, to buy: Pokemon cards, breakfast, lunch, and toys.

After eliciting more reasons for why money is important, Ms. Lee asks the students to imagine that they are in Ms. Lee's general store and asks the students to add up the grand total of some hypothetical items that they are purchasing. Ms. Lee asks the students, "what kind of operation will you need?" A student answers Ms. Lee's query by responding, "add." Ms. Lee provides more instances f when the students must add, subtract, and/ or multiply. She states, "We are going to be doing a group activity where you will be doing all three things." She goes on and states, "I have to introduce you to our grocery store now" and she reveals many small baskets filled with small models of food, such as milk, cereal, etc.

Next, Ms. Lee moves back to the overhead and tells the class that they will be working in groups of 4. She has developed a worksheet which asked the students to list all the items they could purchase and provides problems of where the students will add, subtract, and/or multiply the prices of various sample grocery items to achieve a grand-total grocery bill. The classroom buzzes with excitement

Ms. Lee reminds the students that to receive full credit they must list the operation, show all of their work, and use a calculator to check your work. Next, Ms. Lee divides the students into groups, giving each group a basket. She reviews the directions. The students begin.

#### *Fourth Grade Student Comments (Fall 1999)*

- In math one day we measured our femur bone and height which was a connection between math and science.
- We use calculators in math to check our work.
- Sometimes in math she is talking and then she starts talking about science.
- We took tests on the computer.
- We learned how kites fly in our class.

Mrs. Laura Kern.

*Fall 1998 Vignette.*

The lesson begins with students working in groups around the classroom. One student is working with a calculator; another student appears to be counting money; a third is counting on her fingers. Mrs. Kern helps a student with a calculator. Mrs. Kern says, "Freeze." The class begins to quiet down. She says "Freeze" again. The class is virtually silent. Mrs. Kern says, "Each of you have had ten minutes to play customer once and cashier once." "Now it is time to finish up your math work, some of you are maybe finishing that last problem and that is OK, but in the next 30 seconds or minute, finish up the chart then turn your paper over and write a letter to your parents or whoever you go home to, persuading them to give you more money. You need to tell them exactly how much you need and why you need it." "For example, if you want to buy a pencil for everyone in the class and each pencil is 12 cents, you figure out that 12 cents times 23, equals whatever amount, you need specific with them how much you need. A voice in the background interjects, 24, because you are someone, too." Mrs. Kern says, "Oh, if you want to buy one for the teacher it would be 24, thank you Andrew." She goes on, "so, be specific about how much you need and exactly what you will be buying; OK." A boy asks, "what happens if you want to buy a bicycle?" Mrs. Kern replies, "I don't think the school store sells bicycles." The students giggle. Mrs. Kern goes on, "but I think they sell T-shirts, I think they are 5 dollars." The class yells back, "they are eight dollars." Mrs. Kern laughs, "OK, they are 8 dollars

The class begins to complete their work. After a bit Mrs. Kern says, "Some of you are still being distracted by the money and the school store items in front of you, so lets take thirty seconds and put the money in the envelopes, except for the calculators, I will be around to collect them." The students busily pick-up. After a bit Mrs. Kern reminds the students that "You have about 5 minutes to finish, five minutes to finish." She calls on specific students who are talking and asks them "have you finished your letters?"

Mrs. Kern says to a student who is talking "you are not writing, you are wasting time." She also sends three students who are working to write their names on the board. One student who has not been sent states, "I want my name on the board." The classroom becomes virtually silent. After about 5 minutes Mrs. Kern asks, "who would like to share their letter with the class?" A girl comes to the front of the room and reads her letter to the class. "Nice job Becky," praises Mrs. Kern. "Would anyone else like to read?" Hands go up. Mrs. Kern calls on a boy and asks him to wait until he has everyone's attention to read. The class becomes quieter and the boy reads.

Mrs. Kern asks the class "what is one thing missing from his letter?" A student responds the cost. Mrs. Kern asks, "how much does one T-shirt cost?" The boy who read the letter responds, eight dollars, \$200 total." Mrs. Kern says, "one of the things that was said in the prompt was please be specific in how much you need. For example, "I want to buy 25 t-shirts that cost 8\$ each so my grand total is \$200." Mrs. Kern suggests to the boy who read the letter that he add that information.

"Would one last person like to share?" A boy moves to the front of the room and reads his persuasive letter to his mother asking for 2 dollars to buy a mechanical pencil. Mrs. Kern asks the class to give the student silent applause which they do. The lesson ends with the students getting ready to go to the media center.

*Third Grade Student Comments (Fall 1998)*

- One activity that really helped me in math was when we rounded up the blocks and put them in factions.
- We used calcuelators [sic] in science to calcuelate [sic] how long our planet grew.

- In science we learned about bees, queen bees, throne [sic] bees, and worker bees. We were using dead bees for the experiments.
- We used a computer to do a project.
- We used a calculator in math to check our work.
- We used calculators in science to see how much our plant grew [sic].
- I really learned science when we used the tuning fork. When we put the tuning fork in the water I learned that vibrations in the water is [sic] fast.

*Fall 1999 Vignette.*

Mrs. Kern begins the day's math lesson by with a warm-up on the overhead projector at the front of the room. The warm-up begins with the phrase: On the first day 4 campers arrive, filling up a cabin. On the next day, 8 campers arrive, filling up 2 cabins. Each day the number of new campers are double the than the day before. After six days, how many campers will there be? The class seated in desks arranged in-groups of 6-7 student's work diligently on the problem. Mrs. Kern walks around the room monitoring students working quietly at their desks. After a few minutes, Mrs. Kern returns to the front of the room and asks the students, "Raise your hand if you made a table or a chart." One student hand is raised. She then asks, "Raise your hand if you did something different." Several student hands go up. Next, Mrs. Kern asks the students what mathematical operation they used to solve the problem. A student replies, "I doubled." Mrs. Kern replies "you did an adding operation" and goes on to summarize several other problem solving strategies that the students shared with her.

After a few moments, Mrs. Kern asked, "Can anyone describe how they solved the problem?" A student describes to her attentive classmates how she solved the problem. Another student offers her strategy for solving the problem and mentions that she got 24 for an answer. Mrs. Kern asks, "raise your hand if you got 24 for your answer." Several students raise their hands. Mrs. Kern asks, "Raise your hand if you got something different than 24?" More students raise their hands. Mrs. Kern asks the group, "do you think your answer will be bigger than 24?" One student responds and says, "so far I have 84." Mrs. Kern replies, "let's think this out loud together. OK, let's see about doing a table for this one. This is a tricky one." She states, "What we know is that each day the number of campers doubles." "On day 1 we had four campers come, on day 2 we had 8." "What is 8 times 2? Mrs. Kern begins to lead the class through the problem by filling in a chart that reflects the number of campers in the camp on each subsequent day.

After filling in the chart for 4 day, Mrs. Kern asks the class, "do you see the pattern?" The students nod their agreement and some say, "Oh yeah." Mrs. Kern asks the students how they "messed-up." Two students unabashedly share with the class how they "messed-up." The class continues in this vein until the warm-up problem is solved.

Mrs. Kern continues and tries to get the class to figure out how many cabins are filled after six days. Through patient questioning and the use of the chart she designed, she leads the class through the problem. Several students appear to catch-on and have their hands eagerly in the air ready blurt out an answer. As more of the students seem to catch on to the process, Mrs. Kern calls on of the students whose hand is in the air. The student states, "You need to add." Mrs. Kern states, "That is right, you need to add day one, plus day two, plus day three..." Mrs. Kern describes how she got the numerical answer while walking around the room checking students' progress. After a few moments, Mrs. Kern states, "Raise your hand this is still unclear to you, if you don't understand why we added." Several students raise their hands. Mrs. Kern asks, "What is confusing? Several students share what part of the problem confuses them. Mrs. Kern helps the students reason through why they got an incorrect answer

Using the overhead projector, she wrap-ups the warm-up by revealing her written answer to the problem. She asks the students to grade her response. Mrs. Kern asks the student to show, with their fingers on a scale or 1-3, what her score is. Most students score her answer as a 3; several score her answer as a 2. Mrs. Kern then instructs the students to put their binders away so that they begin the next part of the lesson.

Mrs. Kern introduces geometric figures made from marshmallows and sticks. She asks the class what they could be called. The students offer various answers: Solid figures, prisms, or



geometric solids. Mrs. Kern states “in the past we talked about squares or just hexagons, these are prisms which are three dimensional solid forms. Today you will have a chance to make a few of these. You will also combine some writing.

Mrs. Kern asks the students to look at the packet that she has developed for the lesson and states, “this is a bit like [statewide student performance-based test].” She asks the class, “what do you think geometric solid is” and asks the class to write down their ideas. She then asks, “OK, who thinks they have a good definition of a geometric solid?” A student states “I think a geometric solid has more than one side, it is mostly polygons.” Mrs. Kern responds, “great, two good math words, side and polygon, good.” Anyone else? Another student responds, “I think a geometric solid is a four sided polygon.” Mrs. Kern asks, “four sided, do you have example of some that are maybe six-sided?” The boy shrugs his shoulders. Mrs. Kern responds, “think about it and I’ll get back to you.” She calls on another student who says, “it is a solid polygon that all sides are parallel.” Mrs. Kern responds “parallel, another good math word. We’ll think about that one.” Mrs. Kern asks another student who responds, “a solid polygon that has more than one face.” Mrs. Kern responds, “face, a new word, and you used polygon and face.” Mrs. Kern continues to solicit examples of student work. The class sits and listens attentively to their classmates.

Mrs. Kern tells the class that they will return to their definitions after they construct some geometric solids. She states that some “Hit the nail on the head” while others did not. However, once they construct the solids and fill in the chart, they will better understand what a geometric solid is. Mrs. Kern describes some techniques about how to construct geometric solids using sticks and marshmallows. The students work at their desks.

#### *Fifth Grade Student Comments (Fall 1999)*

- In this math lesson, Mrs. Kern helped us by giving us questions, teaching us lessons time after time. She’s taught us by being a great teacher.
- A lesson in which we used math and science is when we graphed the ozone.
- We used calculators in math. We used them for division.
- Mrs. Kern’s plans fun activities that help me in math.
- She gave our whole class a rubric sheet of points.

#### Ms. Katie Phillips.

We had no vignettes of her first year teaching to report.

#### *Eight Grade Student Comments (Fall 98).*

- In math we went on the computer to learn about different mathematical terms and to draw constructions.
- She explained how to read the scale and told us detailed instructions on how to do the science experiment.
- We used the computer to get weather reports on the internet.
- We made graphs on the computers using rainfall data from other countries.
- We mixed chemicals together to see how they react.
- We used calculators in math.
- We used computers often to collect data.
- We used the computers and calculators in math to calculate, research, and learn all kinds of things. We used computers in science to find information for the labs that we did.

#### *Fall 1999 Vignette.*

In Ms. Phillip’s borrowed first period class the desks are arranged in rows. As the students enter the classroom, they begin the warm-up, which is projected from the overhead projector. The pledge of allegiance and the school announcements are read over the public address system. After the announcements, Ms. Phillips asks the students to take out their homework. She walks around the room checking their work and marking their progress in her gradebook. She states, “I am also collecting the classwork from yesterday that you should have finished.”

When Ms. Phillips finishes assessing and collecting the students' work, she walks to the front of the room and announces, "OK, for the warm-up today I wanted you to solve two inequalities and they were just like the ones you were working on yesterday." Using the overhead projector to share her work, Ms. Phillips leads the class through the solutions by asking, "Who can tell me what would be the first step?" Ms. Phillips calls on a student who leads the class through the solution. Ms. Phillips asks, "Any questions on that?"

Next, Ms. Phillips begins to hand-out papers. She states, "When you receive the packet, I want to read it over so you can see what we will be doing today. And you should clear everything off your desk except a pencil." The students begin to clear their desks, pass back the papers, and read the packet. Ms. Phillips distributes rulers.

Ms. Phillips leads the class through the instructions of how to construct triangles with spaghetti. She gives the class one piece of spaghetti and the students are asked to break the spaghetti twice and make a triangle out of the pasta. Next, they are to place the pasta on the paper and trace the triangle with their pencil. After their triangle is formed they are asked to record the length of each side and label each side A, B, and C. The students begin to break their pieces of spaghetti. After a few moments, Ms. Phillips asks, "How many people figured it out and got a triangle?" Ms. Phillips, using the overhead, demonstrates the breaking of the spaghetti to form a triangle. She labels the triangle

Ms. Phillips asks the students to make some observations about the lengths of their triangles' sides. "So just make some observations on your own about the lengths of the sides of your triangles." Ms. Phillips walks around the room checking the students' progress. Ms. Phillips asks, "What are some observations people have made about the lengths of the three sides?" Several students share their observations about their triangles. Ms. Phillips leads the class through the rest of the exercise alternating between teacher centered and student centered modes of instruction.

#### *Eighth Grade Student Comments (Fall 1999).*

- In science we used computers when we found information about weather at different places. In math we used calculators a lot every month.
- She explained how to do what she was teaching. She also always answered questions and helped any1 [sic] who needed help.
- She used hands-on activities in math. This made it easier and more fun to learn.
- She taught me that when you have a triangle and you add two sides up, the length of the third side is smaller than the length of the two sides added together.

#### Mr. Mark Jones.

We had no videotapes of this participant's teaching or any of his student comments to report.

#### Ms. Mary McDonald.

##### *Spring 99 Vignette.*

Ms. McDonald begins the class by asking the students to jot down some ideas about geometry. She states, "It doesn't have to be a paragraph, I just want you to jot down some ideas, some things you know of geometry, and then we will read a book about geometry, and then you will use the geoboards to investigate a little bit of geometry. Does anyone have any questions before we start?"

A student asks whether or not examples could be used. Ms. McDonald responds, "Yes, examples are fine. If I know squares have 4 sides, you may want to use that example." The students begin to write away. Ms. McDonald circulates helping students. Ms. McDonald walks around the room, handing out papers. Students continue to write.

After a few minutes, a bell rings and Ms. McDonald says, "OK people, everyone stop, drop, and look." Many of the students raise their hands. Ms. McDonald says, "Excellent, excellent, give yourself a pat because you are 100%." The students pat themselves on the back. Ms. McDonald states "If you are at an even number table and your plant has a bud on it, move to the rug. OK, if you are at an odd numbered table and your plant does not have a bud on it." The class moves to the rug where Ms. McDonald sits, ready to read the class the book, *A Greedy*

*Triangle* by Marilyn Bernstein. Next, she asks some of the students what they know about geometry. Eight students share what they know about geometry. Ms. McDonald begins to read the book.

When the book is finished, the students move toward their desks. Ms. McDonald says, "We have done this before, you are going to, in stations, move around the room. We have a half an hour left of math, and I am going to give you 7 minutes at each station. She asks the class, "How many people have never used one of these boards before?" Two students raise their hands. Ms. McDonald responds, "You'll get a lot of practice today."

Ms. McDonald tells the class, "On each table there is a piece of paper to take that gives you some directions to follow. You are going to investigate different shapes. You are going to find out how many sides and angles different shapes have. You are going to get used to the words. I don't expect you to know all the words. That way if you see these words again, they won't be shocking...."

Next, Ms. McDonald demonstrates how the students will use a geoboard. She goes on to explain that each station takes you through a different shape, asks you to do a little writing and asks you to relate it to different subjects. Ms. McDonald asks the class if they have any questions and then sends the students off to work in teams of 2 or 3 students. The students begin their work.

### *Third Grade Student Comments (Spring 99).*

- My teacher taught me science and math by helping me learn by doing experiments [sic] and activities.
- In Science, Ms. McDonald helped me understand how bees pollenate [sic] by reading a packet. In math, she helped me by explaining it to me.
- In math my teacher helped me learn mathematics by working in groups.
- My teacher helped us learn math when we did projects. The projects really helped me to understand math.

### Question 2

To answer our second research question ("What supports/constraints impact the introduction of new practices (reform-based) by new specialist teachers of mathematics and science who graduate from an inquiry-based, standards-guided innovative undergraduate teacher preparation?) we analyzed data collected from the individual and group audiotaped and transcribed interviews (participants and principals), and participant reflective writings.

*Inside Perspective.* The participants' individual and focus interviews conducted over two school years were the data sources for the inside perspective on perceived supports and the constraints the new teachers faced in enacting their reform-based visions of practice in their schools. We found it informative to report the voices of the participants over time (first year fall, first year spring, and second year fall) to illustrate changes in the participants' perspectives over the study period.

### Supports

#### Ms. Susan Lee.

#### **Fall 98**

I'm teaching fourth grade math and science. I'm teaching an upper level math, a high group, and I'm using a lot of the activities that we did, the hands-on, constructivist activities that we learned in our courses, especially in the methods. I'm using a lot of those activities from [her science methods professor], because it goes along very nicely with the hands-on, constructivist curriculum, and the kids are doing great with it, and they enjoy coming to class. They look forward to coming to math and science. ...I'm so glad that I took those type of method courses. Also, our MCTP content classes were taught in a constructivist manner, so our learning was constructivist, too. They built on our prior knowledge, and those kinds of things, like, all these little facts that I learned in my MCTP Physics course. I didn't forget the knowledge, because the professor built a solid foundation of the science and the math. Those kinds of things I didn't forget, and I'm using that very nicely here in the classroom.

**Spring 99**

Well, what I've noticed, what I've found out, is that a lot of the parents are illiterate and they don't really, the kids don't really have much support at home, and so a lot of the things we do in class is more hands-on so that they can be more independent. Because at home they have to be that way, a lot of them do. The kids are actually able to tell their parents what they did. They can explain, Well this is how we learned it." With the hands-on things that we did you don't have to read a worksheet and say, "Well, Mom, Dad we learned about electricity today. This is the worksheet that we did." The parents come in and they're just so excited. Sometimes they come in and they say, My son is just so happy to be in your class and he's learning so much. Everyday he comes home and tells me everything that he learned throughout the day."

**Fall 99**

I have noticed that I have more [content knowledge] than the veteran teachers that are here. And they're finding that they need to ask me some science-related questions. I'm not saying that I am the guru and the expert here on science but I find that I'm pretty prepared for the content area. I'm teaching electric circuits, and we had that in physics with Dr. Layman and I learned a lot in that class. ... What I notice is that the more and more experience I get, how much easier it is for me. And I think because I have that solid foundation already, it's just really helped my teaching.. And it's just something I can't forget, I don't forget anything that I've learned in the courses that I took because it's been very helpful to me... It's just made things so much easier and it's made, you know, results in the classroom are even greater ... I mean if I were to compare - I know you really shouldn't compare how students learn in different classes because everybody's teaching styles are different - it's just the things that my kids can retain, I'm very pleased with that. Obviously, they do forget some things, but the big things, the things that I stress the things that I really focus on with the hands-on learning.

Mrs. Laura Kern.**Fall 98**

One of the things that both of my official class evaluators, my principal and her vice principal said was that they had never before seen a first year teacher at my level of using higher level thinking and questioning. They found it a real surprise to see that in a first year teacher. And it's not something that I even feel like I'm trying to do, not like I am always thinking, okay, let me think of a higher level of question, but I think it's for being in my MCTP courses, such as my science methods' course, where that kind of teaching was modeled. I just kind of picked it up, you know? In support of the MCTP ideas in my district they offer workshops. I went to the county science workshop at the beginning of the year, and they were helpful just to familiarize yourself with the way things are expected to be done to prepare students for the state performance examination. We had two mathematics state performance assessment workshops in which we took the bigger student performance math activities, and making smaller ones, so that we can, you know, use them regularly with the kids. I've used those workshops to kind of make up my own kind of things, like, using our school store price list to make up some problem solving things.

**Spring 99**

School personnel help a lot. I have this person who does a whole lot for me by getting math materials ready. So I get a lot of support in the math area. The science, I mean I can't say enough good things about the districts science kits. I mean they kind of limit you to just kind three topics per year, but they really plan them well and there's lots of hand-on activities and lots of, you know, integrative activities.

**Fall 99**

A lot of teachers don't like the [statewide student performance-based examination], but I kind of like it. It goes along with the MCTP and how I was trained. So I really like it.

Ms. Katie Phillips.**Fall 98**

I have a principal who is very supportive of all the MCTP sort of ideas, so she was really excited with me coming in that I had had the math/science background. And she also like the fact that I had



taken an elementary teacher preparation track because she came from an elementary school. So she had a lot of the same sorts of ideas of things that they had taught in elementary education that maybe some of the people who just went for secondary didn't get, so she's very supportive....I think that my district is supportive and it's moving probably even more that way because I know that the district's curriculum is changing a lot. They're moving from just having split subjects every year to more of a spiral in science. And in a couple, in two years I think it is, there are going to be many different things in the 8th grade--not just Earth Science. We'll be doing Earth Science and genetics and some other things. So it's more of a spiral curriculum and I know that that was one of the things that we had learned about in the MCTP methods courses.

#### **Spring 99**

I guess pretty much that the administrators are supportive of my MCTP teaching. For example, my principal recently supported me in a conversation with one parent. I had one parent yell, pretty much yell and scream at me at a meeting the other day, about the ridiculousness of a project that we just did in Earth Science, where the kids had to make up a fossil that existed during a specific period of time. And the main reason was to get them to research the fossil. Research the time period and write a research paper of the time period and put a fossil that would belong in that time period and then create an animal around it. And we wanted to do it because it gave them the chance to be creative while learning about something new and really applying what they had learned to create their own creature.

#### **Fall 99**

I think that in my math methods and in my science methods I got a lot of ideas for ways to do things by, you know, starting out and posing questions to students and using hands-on and having things that are opened-ended sorts of problems. I don't know if I would of gotten all of that if I hadn't been in the program.

#### Mr. Mark Jones.

##### **Fall 98**

My principal is very supportive of me. He wants me to involve the students in problem-solving activities in their mathematics lessons.

##### **Spring 99**

I think we have a lot of (well, we need more) but we have considerable amount of manipulative materials. I think I get a lot of support for my hands-on activities and for my process-type activities that I would consider learning for understanding activities. I get the support from the staff and administration for that.

#### Ms. Mary McDonald.

##### **Fall 98**

The student parents are so supportive of new and creative and different ways of, you know, teaching the kids. They really are. The kids amaze me every day, because what they come to school with is so wonderful because we don't have to do any of that moral teaching or the, you know, the baby sitting kinds of things, the mommy kind of things, we just don't have to do it at all; it's all taken care of. They come in. They do the manipulatives with me so that I can, you know, really have different groups going, and at the drop of a hat they'll come in, and they just start learning. They've just been very supportive of the new ideas. They love new ideas actually.

##### **Spring 99**

Well, my community is highly, highly supportive. This community is one that all of the moms, for the most part, are at home. The dad goes to work, and they've got the house with kids and the dog and the whole bit. I think that there's a lot more support here than I think other people are having at their different schools where there's, you know, a lower economic or harder family situation. I think that's very helpful because the parents are on your side. They find your new ideas and your new way of doing things exciting and they see it as something better for their child. And they're really excited by that. My teachers and other employees I would say, for the most part, are very supportive and think the MCTP way of doing things are great new ideas and great ways to do

things. My administrators are very supportive also. They really enjoy it a lot and they think this is great. So, I think all in all, that everyone is very supportive of the different ideas.

### Constraints

Ms Susan Lee

#### Fall 98

Well, I mean, obviously if there's more people watching, there's more people with ideas, and they're going to be, you know, giving suggestions, and it's not always going to be positive, not positive, but they're gonna say, "Well, why don't you do it this way?" I mean, that will place a constraint. I mean, yeah, the more people involved, of course there's gonna be more ideas, and more opinions, and that's somewhat of a constraint, I guess. I don't really if it's a problem, though. Everyone is entitled to an opinion.

#### Spring 99

A lot of the teachers here are much older and may have been in the profession for a long time, and so they do a typical worksheet thing, and they do the note taking and not so many of, like, cooperative learning things. And, there is a lot of direct instruction, that's what I see when I've walked into their classrooms, and what I've heard, and what the kids tell me and things like that. When the kids come into my classroom, and I've had some students come up to me and ask me, "Well, why do you guys get to do this?" And you know, "It's not fair!" and things like that, so I just tell them that it's just different. It's just basically all I have to say. I mean I don't really have a comment on, I mean, "This is how I teach and it's not the same as my other teammates." I'm just talking with respect to the rest of the fourth grade....There's a lot of testing. A lot of the teachers are preparing the students for [statewide student content test] tests, like practicing, practicing, practicing all the time. These formal assessments on everything, so I don't know. I mean I do [statewide student content test] practice, but not so much as they do....Although the parents are interested in what their children are learning, it's hard for me to communicate it because of the language barrier. I mean that's the biggest thing. The parents are very supportive, and they're definitely happy with the things that have been going on this year. But in terms of me being able to explain everything and ask for their support in that manner, it's very difficult, because I have to get an interpreter sometimes. The language barrier is probably my biggest constraint.

I do feel very comfortable teaching in the MCTP manner. My problem is I'm starting to have tension with my other two teammates because I'm teaching differently than they are. And, I am. I prefer to teach this way and I don't see myself changing. And although I am the younger one, I don't follow how they teach. And I've had a lot of parents talk to me and telling me that they want their child to be in my class next year—and the principal is saying all these things. I know I'm not doing anything wrong and the kids are learning so much this year and so, like everything I learned from MCTP physics, just like the hands-on lab things. My teammates keep on pushing these textbooks in my face and they keep on saying, Susan, you have to use this. You have to use this. The students have to answer questions from the textbook. We do answer questions, I mean, we do write in a daily log and we do discuss the book, but we don't do the whole section in a book chapter and then answer the corresponding questions to it. We had a team meeting, and they came up to me and they just said, I mean, of course they were positive at first, I mean, we get along very well, but then they're starting to say things like, they think that my method is just a little bit, well, they think they *cover* [participant's emphasis] more things. I said, "Well, you may cover more things and they may remember it short-term, like on short term to take a test, but what about later on when you're building from it?" And so, we were having a little bit of a problem. Actually, now, they're starting to take more of my things. Like before they wouldn't take anything; they're much older than I am. And, I guess it's hard for them to see someone new come in and kind of steal the spotlight and that's the way they see it. I'm not being negative because I think they're very sweet ladies, but they just teach differently than I do. They're starting to come up to me and say, "Well, how did you approach this? They're starting to use some things, which is good. But, it took a long time for it to come to that point."

Mrs. Laura Kern

**Fall 98**

And integrating science into math--I don't really do that much of it in my classroom, 'cause we have so many math objectives to meet. I'm really kind of struggling to keep up with math, but the science kits are really well planned and also contain a lot of connections....We don't have a computer lab; we just have a media center, so classes come in for twenty minutes book exchange. There's, like, sixteen, maybe fourteen, computers, that kids work in pairs at, and you're supposed to instruct them with all that other stuff goin' on, and I just think it's pretty much in one room. You know, maybe I'll get more confident and comfortable with it with practice, you know?

Well, it's not like something, I mean, it's kind of like what Estelle [her student teacher cooperating teacher] always told me, because, like when I came as a student teacher with her it was, you know, mid to late September, and, you know, "Let's put you kids in groups, and just throw some unifix cubes at them and let them explore." And you can't do that right away. And especially I've got two SED kids that can't work in groups, you know?

I feel a little bit restricted by the science kits. Even though I like them, and I like the way they're set up. There are three separate units. One is a life science. Next is chemistry, and then there's physical science. So there's really no connections between the three of them which I don't like. And then it's kind of up to us to use them. There's about a three-week break between kits because of the way they're rotated through the school, that we just kind of we can teach whatever we like or enrich the unit, the previous unit, or kind of preassess. Or, do some introductory activities for the upcoming unit. So I kind of feel like if they're gonna really mandate that program, that they should kind of make it, you know, with more connections. And kind of make the kits, like, year long rather than three, you know, nine-week or however long we have to get the unit....I'm disappointed in that the curriculum is set. I just kind of wish that I had a little freedom with, you know, maybe selecting topics. But that's just their grade curriculum, and that's the way it is.

With math I really like the idea of the instructional outcomes testing. But sometimes, I think I kind of went out of order with the units to kind of cover as many objectives as I'm supposed to and make more sense of it with the kids. Again, I guess I kind of do feel a little restricted by that, too, just because they kind of tell you the first ten days is for graphing, and the second three weeks is for addition, and you have to cover these three areas. So it's like, what if, you know, something comes up and you really want to extend something a week? Then you're behind a week for some other objective. The curriculum is pretty tight, I think, and there's really not much room to kind of stray from it. It's just, it's really kind of rigid.

**Spring 99**

I'm not as pleased with the technology infusion as everything else I've been doing here. I have a lot of complaints just about the way our technology is distributed. I went to a real neat four day workshop. It was called ITIP, Integrating Technology, I don't know what the acronym was for, but it was four days and we were just learning ways to integrate technology in the classroom, and I made several attempts to do things, like a Hyperstudio, which really was nice because we did that for our Arts and Academic Night, so the parents got to kind of go through. But as far as the digital cam, nobody can find the chargeable batteries, and you're supposed to go to the Media Center Specialist first. And then she sends you to somebody else, and then she sends you back there and apparently there are all these color printers in our building, apparently there are 13 but nobody knows where a single one is....And so I kind of feel like there's a real push for technology, but they kind of want to keep it under lock and key and you can't use it. I'm a little disappointed in that here. So I haven't been able to use it as much as I'd like. And the other problem is we don't have a computer lab; we have those hubs in the media center.

Math and science, or math and anything else, and so I kind of feel like in order to be successful in making connections like that you need to have the same group of kids. And at least for half the day. So I'm kind of frustrated with that, and I think that it's nearly impossible with our schedule.

for us to be real, real consistent on planning and teaching the same thing, and giving students the same experiences, and making the connections just because of the way we switch so much. Every 40 minutes I have a different group in the afternoon. ...Like I said the science kits' activities are really nicely planned and meaningful activities. But at the same time, it would be nice if something just came up, not to have to be doing the science topic sound right now. Like you know, just if something came up we could do it, you know? But it's pretty much spelled out. We have, you know, we have eight weeks of plant growth, eight weeks of crime lab, and eight weeks of sound. And, you know if there's free time we've done other things, but that's kind of a constraint.

I keep talking about this [district instructional outcomes testing] and it's all of these objectives and you need to have these resource sheets that the kids need to have, and then you have to test them on these certain objectives, either like bubble sheet tests or demonstration models and things. So it's kind of neat but it's also a lot of paperwork for a teacher to keep up with and it's a lot of, I think, extra work....it's just kind of a pain in the tush.

#### **Fall 99**

The gap between students in your class is a major constraint. I have some students that have only mastered second grade objectives in some topics, whereas others have already mastered some sixth grade. So, and even though we regroup for math, and I'm supposed to have somewhat of a homogeneous, I still have a gap of about 60 objectives. And that's a lot. So I have a student like Jessie, who's extremely low, and he also has a language barrier, then I have someone like Demiel who shot out seven solids in just a matter of 15 minutes. That's really difficult. I don't think any training could prepare you for that, and it's hard, not just for me, but for all the fifth grade teachers. I feel like where I'm letting students down are the ones that are higher or more able. I'm afraid that I might be slowing them, because I'm trying to catch the lower end up. ...And last year my principal was really different. She was real, real, real supportive and, not that my new principal isn't, but he is so data driven that all he sees is numbers. That's all he sees. And so that's been real, real frustrating this year. My principal, or someone else, has formulated that according to the children last year who took the [statewide standardized exams], all the children who were every quarter at that 2/3 mark on the district instructional outcomes or better or higher, met proficiency on [the statewide test. So he's saying that this year that should be our goal. But it's a different set of children, was my argument to him. And he said, "Well, I guess mathematically speaking, you're right. But there's no harm for you guys to set that as a goal for your class." So, it's okay, but now I'm dealing with, this year I have the low group.

#### Ms Katie Phillips

##### **Fall 98**

I don't like having to use the [district instructional outcomes tests.] Those don't support, I mean, anything that I think I learned while I was in college. And it just drives me nuts having to really do these. And it all falls on you when you're an eighth grade teacher, because it's the last year. If they don't have them all passed, then it looks like you haven't been giving them when really it has been all along that they have been missing things, so that's something that I really don't like about the county. I usually have to donate at least one day a week or something toward working towards getting some of these [county testing] done. It cuts down on the time that I can teach the sort of things that I like to do, that I would like to be doing.

##### **Spring 99**

I think it has a lot, but in some ways I think I'm not always to use everything that I was taught, or what I did learn in MCTP because of time constraints and because of curriculum requirements of the county, and because of the level of reasoning of some of the students. Because I know that a lot of the stuff that we learned about in MCTP was higher order thinking and questioning. I know that a lot of the stuff is just very hard for some of the students to understand when they have a tough time answering just simple questions. They are better at just remembering or memorizing sorts of questions....It's hard to get on computers. They are limited. and I do like to use them, but I think that in this school particularly, a lot of people use technology just for the sake of technology because it's there. It's like tonight they're having a technology night at the school, and I'm not a



part of it because I didn't have any special thing that I did. But half the time I think that they're doing it to kind of show off for the parents, "Look what we can do!" There are some nice things on the computer that they can use, but a lot of them are more tools for presentations: "Look at this report that I did, but I did it on the computer!"

A constraint is all of the testing and things. I think that my county is really test happy. We just have so many tests for everything. All the time tests and quizzes. And right now, basically, the rest of the year it's, like, forget about it for any doing any real teaching. This week we've got two days of the week that we're not really going to be teaching. Tomorrow we've got test practice, and then coming up, we've got a whole week of the [statewide testing]. Then we've got all these [statewide content test] practices. And basically, from April/May we're just teaching to the test is all that it is. They put a lot of stress on teachers. I mean they have, we have our faculty meeting and sit for an hour and learn strategies to teach kids how to do well on the performance-based test and how to do well on the statewide content tests.

#### Fall 99

I thought it would be easier this second year. I mean they really told me I'd have an easier load. I don't teach Life Science anymore, which I'm thankful for, but I'm moving around now even more than I was. I'm only in two classroom, but I'm back and forth four times, instead of moving three times as I did last year. This time, I'm like back, forth, back, forth, four times. Three of Earth Science classes, two of math. And I have some GT this year for science. I have one cluster class. I have one GT class, and I have one low-level regular class of science.... I feel like I don't get to spend enough time really planning for the things I would like to plan for because they put so much pressure on me to do other things. Like the on-line attendance. The on-line grades. Just all the other stuff I have to do.

Science is a lot harder to teach than math. Math is a lot easier to prepare for. Math's a lot more organized. Sometimes the students can be a lot more serious about their math scores, and just about math in general, because they are always worried about that math grade. "What level of math am I going to be in next year?" And they see it as a lot more of an important class than science.... The problem I have, which is driving me crazy, at my school there's the push for the Algebra initiative. That everyone be in Algebra by the 8<sup>th</sup> grade. And they're just not developmentally ready. So they've all kind of skipped this one section of math that they were supposed to have had between 7<sup>th</sup> grade and where I am now. Another thing is, 7<sup>th</sup> grade teachers didn't do the district's instructional outcomes last year. I had kids say, "What is an instructional outcome? I never heard that before." I was told that one of the teachers, who was no longer at the school, would just go and tell the school's instructional outcomes administrator that they had passed them all. Everybody passed this test. And would just tell her that, but the administrator never saw the tests. And that teacher was lying. Another thing is, they never had homework last year. The students complain constantly, "Why do we have homework in math?" You always should have homework in math. "We never had homework last year. Why do you grade our papers? They were never graded last year. Why can't we have more fun?" And I know I like to have fun, and I like to do, you know, fun things, but I say, "What did you do last year?" "Well, we sat in groups and played games every day." Well, that's great and wonderful but they weren't really playing games where they were- they would sit and like play checkers and things like that in math class. Every day. So, I don't know. Now the [district instructional outcome] thing is a pain in the butt.... Nobody has any idea what I do in math. Nobody cares what I do. I mean, maybe test-wise they care. I know the math head just thinks that she has so much to do and doesn't have any time for anything anyway, so she really doesn't care. I guess she's supposed to come and observe me sometime, but I'm sure she'll walk in for a second or so and then write up a good observation and leave, because we're friendly with each other. So, you know, "If we're buddies, you're doing a good job."

I know that one of the things that MCTP is concerned about is keeping teachers in teaching and making them want to stay. But I just don't know if this is what I'm going to want to do forever. I just can't tell. I cannot foresee myself doing this when I'm 40 years old. I just can't. I never think that I would ever want to do any one thing for my entire life. But this, I mean, maybe somewhere else. Maybe I'd like to transfer schools. But I think that the emphasis coming down from the top down is just not where I want it to be. Test scores need to be here. Standards need to be raised. Teachers are accountable for all of this. And I mean, we can only be accountable for so much. Like I said, they are eighth graders now. They've been in school for what 7 plus years? It's not just the principal. It's the whole county; it's the whole state, it's the whole school system. Everything. It's just too much emphasis is put on test scores and accountability to teachers. And I don't know. I just don't like the way the whole system goes. I don't like the whole, I don't know, maybe I'm too extreme, I don't like grades, I wish I didn't have to give grades to anybody. I wish we could just focus on things that are more important, because I don't know, Just the things that people think are important are not the things that I think are important. I mean sometimes I just feel like, you know, a warden. I don't really have that much creativity. I'm just, "Here's what you've got to do. Do it and do it the way we tell you to."

Mr. Mark Jones

**Fall 98**

I kept telling the students they were going to go outside for a math lesson; they wanted to get outside. I kept saying, "We're gonna go outside and do a group problem solving activity," and then it rained. The next class, "We're gonna go outside," and then I had a formal observation and needed to stay inside. And then we had a fire drill another day, which turned out to be my opportunity to do it, since we were already outside.

**Spring 99**

I was talking with one of the other math teachers today, and he was particularly bemoaning the fact that it's difficult to get access to the computers because we have one computer lab. In fact one of the periods of the day there's just no way we'll ever be allowed to use the lab. And so it's difficult to plan if you're teaching the same curriculum in two or three classes. It's kind of difficult to plan for one to be able to do one activity and the other one not. So that makes it even harder on us.... The [district instructional outcomes tests] prevent me from doing a lot of MCTP ideas that require giving time to some activities plus meeting my testing objectives. It's really, the system. I think the county has put its math program into a kind of box or something with the [instructional outcomes] objectives. Not that they're wrong. I just think that the way they're implemented, the way that they have to be covered really, it's confining. I guess I feel it's very confining....One constraint is the time for the team concept that many schools have. So, I'm not able, it seems like what I do is confined to my room and I can't get it out.

You know, I think honestly, I feel like it's been a wasted year in applying what I learned in the MCTP program. I shouldn't say totally wasted. But I haven't come to fruition, obviously. You know, I want to be positive, but I keep thinking of my experience, and I'm looking back, looking at how my year went what I was dealing with the first semester. And I think, boy, it's a good thing I got anything done. The target kept moving, the curriculum kept changing....The teacher that I was supposed to sort of model after left in December. He was out the door, so we never worked together. And I was supposed to be teaching a pilot mathematics program, but I was given a regular program. I was told by my team leader to follow how another teacher was teaching it. But that didn't work. So, about two months into the year I just told her that I can't teach the way this is going. She said, "Okay, you can teach the way you want." So I did that for about two weeks, starting changing my curriculum, and then she said, "Oh, we have a new teacher coming on. I want you all on the same page. So I had to go back, try and get back. And then there were the district instructional outcomes to meet. So, when I came up with a really nice project, a MCTP-type project and I got the students hook, line and sinker, you know, I've got them all excited, and then they want to know more, I had to say, "Sorry, we've got to stop because the district

instructional outcomes take us over in this direction now. Those outcomes are really constricting, very constricting to do the MCTP type of teaching.

Ms. Mary McDonald

**Fall 98**

It's not as easy, you know, as you think it would be, to make connections between math and science, because in my county the two curriculums are meant to be so distinct; they're not they really haven't made them so that they go together....I'm the only new teacher there, and I think since awhile. The majority of them are, you know, in their forties and fifties. They've been doing this for awhile, and they see me as, you know, as somebody new with all these new ideas. I get a lot of, "Oh, you know, you'll slow down once you get used to this." Or, "Oh, she's new. She's trying to, you know, kill the world."

I think there's also this desire from the parents that everything is the same across the board, like, all the third graders are getting the same, you know, type of instruction, they're all getting the same quality, I think, is what they're really after. So I think that unless I can get my team members to do a lot more of what I'm doing, I can't do so much of it. I can't go way out there on the limb, you know. They also have this need for concrete evidence of how their child is doing; they want to see the papers with the A's and the B's on it, and they want see, you know, that they can multiply this. And I can't prove to them that their child understands why two times two is four. Their kid just seems to be able to explain that, or I can show them that they've written it, but there is still this mentality that they need the grade, and they need the A, B, C kind of grade. They don't understand at all. I put a four on it, and they're, like, "What do you mean? Why did she get a four out of a hundred? Oh, my gosh!" No, no, no. Four out of four. But we have to go back to step one and explain the whole procedure, and then they're, like, "Oh, that's wonderful," but they're just not used to it. So I think that kind of puts a little bit of a strain on it, and they all have their understanding that their child is brilliant, and gifted, and can do it all. You know, that's just the mentality, and that can be harder. So, you know, it's a kind of, "Well, yes, she's very bright but, you know, we've got areas to work on."

**Spring 99**

I think sometimes when, you know, when there are parents at home a lot who are very involved in their children's education, some parents can become overly involved when it is something new, or something different.

Outside Perspective. The primary informants of the outsider perspective were the participant's principals. As building managers and instructional leaders of their schools, their perspectives were viewed as informative statements by powerful representatives of the school district on how the new teachers were perceived after a full year of practice in the workplace. During the summer immediately following the new teachers' first teaching year, they were asked to reflect on both the supports and the constraints (or, as one principal renamed it, the "challenges") the new teachers faced in enacting their reform-based visions of practice in their schools.

**Supports**

Ms. Susan Lee's Principal

I nominated her, along with the PTA and other community members and staff, for the Sally May First-Year Teacher Award. It's a very prestigious award. It's a national award. To put it in a better perspective I've never nominated a first-year teacher for an award, for the Sally May Award or those types of awards. I never felt that I had one that was of this caliber....Her ability to integrate and make those connections with math and science is considerable. She does it in very wonderful ways, by portraying different characters. I can't remember the actual character names that she uses, but she dresses up for this. The kids love it. The parents love it. Yet, what I like from that is that it's another way to hook your child into a particular curriculum area and that she has this span, not just during the specified subject time, such as a math class, but she'll interweave this during reading and language arts, so that those connections can be there, as well as bringing it

back up during her science time. Each unit is very well-scripted and she's elaborated on it in some wonderful ways that the kids have that have enabled them to be very successful - their writing about it, their data gathering, their ability to conduct investigations....She's one of the best prepared people to take on [our school district's] public schools curriculum in those two areas that I've had the privilege of working with in the last, at least, ten years....At times, some of the veteran teachers sort of wonder, Well, she's only a first-year teacher, but look how fast she's picking all these things up. They've been amazed by that. I just have been very pleased.

#### Mrs. Laura Kern's Principal (1<sup>st</sup> Year)

She's just a 100% teacher, always looking for ways to make connections with the students and then with the students' parents....She also did a very nice job with sending home a little weekly report to the parents from her class, which was very simple and very much to the point, but the kinds of one-pager that parents could grow to depend on. It was her initiative and I used it as an example to other teachers. It was very, very well done. And toward the end of the year, she turned student teams into editors and they were very, very proud of that. They would decide what the information was that they needed to put into the letter for the parents, and who it was they had to thank for having helped out in the class and that kind of thing. And, again, this is Laura's way of passing the ownership on to the students which is really one of her strengths....She was head and shoulders above other teachers. She has a great deal of confidence. She feels, and she has expressed that to me a number of times, she feels that she has been very well prepared. In the fields of math and science, she was not only excited about the teaching, but felt very comfortable and like she wanted to get down to business....And we have a student body that is very, very diverse. Very mobile. In large part, newly-arrived in the US, so these are students who need skills that are going to be practical and they benefit most from teachers who have an open mind, who can see the strengths that each child brings to the classroom, and manage the weaknesses. And Laura was very much prepared to do that. She did not take the approach of a possible road for a teacher to follow by saying, "There is so much that these children need that I don't know that I'll be able to make any progress." Or, "Where do I begin?" She always had a plan of attack and a vision for where she wanted her students to go.

#### Ms. Katie Phillips' Principal

But one of the things that impressed me about her when I interviewed her, as well as the times that I've observed her, is she makes connections between math and science. And that to me is exciting. Is this math or is this science. That's what makes it real world and seamless. And that's the other thing that I see her really trying to do ñ making connections for the students in their real world....And, her confidence and her commitment are above. I mean I even remember the moment I interviewed her, it was a team interview. I usually involve a team of people that would be working with her and that person would be working with. And it was, like, Wow! What a breath of fresh air....She loves both math and science. And by the end of the year, she really did not want to give up either one. I think that's unique and I think it's very important that at the mid-level we have teachers that feel that kind of competency and passion for math and science and they can make some of those connections between the two. And next year she'll be teaching all 8th grade science and all 8th grade math on the same team and will have some of the same kids more than once. And we're pleased about that.

#### Mr. Mark Jones' Principal

I think Mr. Smith's strengths were in teaching for understanding. Upon classroom observations and feedback from parents, Mr. Smith was constantly seeking out whether or not his students were understanding the broad concepts that he was going with....I have a letter that went into Mr. Jones's file from a parent who was completely satisfied with her child's mathematics program and the support Mr. Jones gave that child. And that child was not a student in one of his more advanced classes. I think Mr. Jones had the support of parents. I think for students who were really willing to put forth a positive effort, Mr. Jones had the support of students. For those



students who did not, they probably didn't appreciate Mr. Jones because he kept after them for greater excellence.

Ms. Mary McDonald' Principal

Mary is a whole-child kind of teacher. She is very much aware of all the different facets that make up an individual. And in terms of her working with these young women and young men, she makes the connection between that of their needs, their interests, their performance level, and always raises the bar for further achievement and for further challenge. And she does make connections between mathematics and science in a very integrated kind of manner. Let me give you a specific instance, where she used the science curriculum of that of finger printing, and their whole unit takes place on that of the swirls, the different ways in which you look at the individual fingerprints, of course, every fingerprint is different. Mary charted the results. Not only through the class, but then did algorithms and did the different kinds of, actually, it was the calculations that would be tantamount to beyond that of algebra, but taking it to calculus, an elementary course in calculus, with the interrelations with the results that she got. And that was a full integration but with mathematics and science....Ms. McDonald was nominated through the parents, primarily, but also through commitment of support from her colleagues and by me for Teacher of the Year. Not New Teacher of the Year, but Teacher of the Year. And this is quite an honor. Of course, her name was listed as the person being nominated. She also received at the end of the year something that was absolutely superb. It was a picture plaque of her class and an embossed, engraved plaque that talked about her outstanding contributions, not only to the school community, but to youngsters in particular. And this was submitted to her, given to her by the parents at the end of the school year. We're describing a person who is competent, who is thoroughly prepared, and who is thoroughly devoted and committed to what she does. She is the very best.

Constraints

Ms. Susan Lee' Principals

I see no constraints.

Mrs. Laura Kern's Principal (1<sup>st</sup> Year)

[At this school] you will not hear a teacher say, "The parents are too much of a presence." It's really just the opposite. How can I get the parents to, you know, make sure that there's a time for homework in the evening and follow through? In many cases for our children, the children are here getting their schooling in English and English is not the language of the parents. And in a number of cases, no matter what the language is that the parents speak, the parents are not literate. So, in order to have the kind of traditional support that teachers almost expect, it's very difficult....Laura worked through what ended up being a very difficult situation on her team. The third grade team last year consisted of five teachers. We had five sections in third grade. And three of the teachers were new to the school. Laura was the only first-year teacher on the team, two other teachers who were veterans, joined us from another jurisdiction. So they were new to this system's culture. Laura had a heads-up on the culture, having done her student teaching in it, and the other folks were veterans in the classroom. And the young woman who was assigned as the team leader - that was something that was in place, actually, before I came on board, and suffice it to say, being a leader is not one of her strengths. Some folks when they are given a leadership position take ownership of it and just kind of proceed as if no one else were on the team and take a very individualized approach. And that became an issue. And, ultimately, extra support and some team building and that kind of thing was provided for the members. And the person who was the real leader was Laura. If she were to be here again next year I would have asked her to be team leader.

Ms. Katie Phillips' Principal

As a new teacher, she had many, many requirements and I was concerned that we were almost do her in because she not only taught two 8th grade Earth Science classes, but she taught a 7th grade more biological science class, as well as two 8th grade math classes. So in terms of the

curriculum, she had a lot to master and understand what was the expectation....Not that long ago, six or seven years, this school was an intermediate school. It became a middle school, and I think we have, particularly at the 8th grade, a culture that sometimes doesn't feel quite like middle school. It still has a traditional junior high culture and we have certainly been trying to make a change in that. Make a shift. But there's some hard-core staff here, and Katie has had to work with those people and I hope, not been too negatively influenced about how you think about children as whole learners. She's found some reinforcements here. And I haven't had this conversation with her directly but I know that it's a challenge, quite honestly. For a new teacher that wants to be positive, that wants to look at children succeeding, believes that all children should learn and should succeed. So, that's a cultural shift that I'm seeing slow progress, this being the end of my third year. But the first two years I was dealing with construction projects and building and, you know, stuff that was not directly related to instruction. And so this has been the first year that I feel like a principal....I mean it was terrible for a new teacher [no permanent class, multiple preparations]. It will be better next year but it was tough. She rose to the occasion.

#### Mr. Mark Jones' Principal

He had three different levels of students. Again, that required a great deal of preparation for a first-year teacher. He taught two classes of what would be considered regular-level mathematics. That consisted of a significant number of students who were significantly below grade level. He taught two above-grade level classes of students, who indeed were probably above grade level. And he taught one class of considerably high-level called Accelerated Math for 7th grade, but he taught it for 6th grade students. These students are at the paramount of mathematics classes in the school system, because they are looking to be at least two years above grade-level in mathematics. That's also a separate curriculum than the Math 6 curriculum, either GT or regular. So his plate was quite full with two separate curricula and planning for different diversity of students and different levels of students.

I'm going to say that the County school system and I guess that would include me as well in some ways supported Mr. Jones but also failed him. Failed him in the fact, for a couple of examples, the primary person involved with his mentoring, training, in-servicing fell upon myself as administrator and his math resource teacher at school. And the school system did not provide much support. An example of that is that Mr. Jones and I agreed to his first semester evaluation, which identified three areas of areas to improve upon for second semester. They were all documented areas to improve, with ways to improve and Mr. Jones agreed that they would be areas to focus on for second semester. I feel that out of the criteria (there were ten criteria) that seven of them were effective and three of them were areas to focus and improve upon. I think it would be unrealistic to be able to think that a brand new, first-year teacher would be effective in ten categories they're first semester doing the job. So we agreed with that, and yet the County, following their guidelines for evaluation of teachers, sent Mr. Jones a letter in January stating that because he received three areas of needs improvement, that he would have to improve or he would face dismissal at end of the school year. Even though Mr. Jones and I both felt that there was no chance I was going to recommend dismissal, this was to identify areas to improve. Mr. Jones, after the first semester of working very hard, long hours, making good progress as a first-year teacher was probably at the end of his rope at that letter. And even contemplating quitting the profession. I counseled with him. He wrote a letter to the Director of Personnel expressing that I spoke directly to the Director of Personnel saying that the letter was a form letter and needed to be modified. She agreed. He got a letter back from a subordinate of that person giving the County company line about, "Well, everyone gets this", and this kind of thing. It kind of goes more to the fact that our evaluation system is lacking in supporting new teachers, and veteran teachers, more than it is a reflection of Mr. Jones as a teacher. The tool is archaic and needs revised. So, in that aspect, we tried to have a collaborative type of program for him, but the school system really did not allow that to happen in their legalistic point of view. But I really feel that he felt he was wronged. That he went into this collaboratively. He went into this with me as a partner. We

agreed on his observations, areas of improvement. We agreed on his evaluation. He knew that I did not feel that way about him. I think he felt betrayed by the school system.

Mr. Jones may have been a year too early arriving in our math program. I think our math curriculum does not support what the Third International Math and Science studies supports or what I believe your program supports. However, this year in 6th grade, the year that Mr. Jones will not be here, we are going to institute a pilot program of a new curriculum called Connected Mathematics, which is a well-respected innovative curriculum received by the National Science Foundation Awards.

Ms. Mary McDonald' Principal

I don't know of any constraints at all for Ms. McDonald.

### Discussion

This study adds to the understanding of what happens to reform-prepared new teachers of mathematics and science during their first years of teaching practice. Similar to Veenman (1984), we witnessed to varying degrees across our sample a "dramatic and traumatic" nature of the transition from the teacher preparation program to the first teaching job (p. 143). We did not observe a full flowering of "reality shock," a concept used "to indicate the collapse of the missionary ideals formed during teacher training by the harsh and rude reality of everyday classroom life" (p. 143). Instead, we observed a more complex process of enculturation into teaching practice by each of our new teachers as influenced by the extant school culture in which they worked. Therefore, contrary to other theorists who emphasize use of a developmental framework or cognitive developmental framework to understand the induction of new teachers, we find it more useful in our thinking of what happened to our new teachers to focus primarily on the socialization perspective (Brown and Borko, 1992; Veenman, 1984).

As we use it, the socialization framework examines the enculturation of the teacher into an extant teaching culture (school district and school). The framework consists of two components, the individual's intentions, needs, and capabilities, and the institutional demands, supports and constraints.

*The individual.* We examined one cohort of teachers in this study (five first-year teachers, and, as they continued into their second year of teaching, three second-year teachers). Two salient common elements for these individuals was their participation in and graduation from a reform-based undergraduate specialist mathematics and science teacher education program and their subsequent employment in the same school district. What follows is a discussion of the individuals by select criteria based on our findings.

*Intentions and Needs.* The new reform-prepared teachers intended to enact reform in their mathematics and science practices when they entered the workplace. In particular, the new teachers stated they were prepared to make connections between mathematics and science, to emphasize problem-posing, to use cooperative learning groups, to infuse technology in their lessons, to use alternative assessment strategies, and to emphasize concept and process. As Ms. Phillips, Ms. Lee, Mr. Jones, Ms. McDonald, and Ms. Kern stated, respectively,

I really wanted all of my lessons to be hands-on and meaningful. I tried to incorporate math into science lessons, and science into math lessons, so much that my students would often say, 'This isn't science class, this is math class,' or vice versa. I also wanted to incorporate technology into my lessons....I do try and stress teaching by understanding. I think that one of the things I like to do is find out what kids know ahead of going into a new unit about something and then kind of going from there. And also, teaching through labs and things. I think that some of the things that we do in our science are better sorts of labs for understanding. Where the kids actually go through and set up a lab and do some sort of an experiment rather than just looking at things under slides.

I teach math and science in a completely constructivist approach. I do use some directed instruction, but I do encourage a lot of cooperative learning and letting the children figure things out rather than me telling them everything. We use manipulatives, learning stations, where they formulate ideas on their own. It's more independent..... When I'm teaching a science unit I tie in

the science with the mathematics. And when my students do science, they know it's not just science, we're also doing mathematics.

My MCTP preparation has impacted my teaching in math (the only subject I teach). I think it's certainly directed the way I'm trying to teach and getting more into teaching this way with a lot of discovery-type activities, learning, I do group work, cooperative work. I'm doing a lot of, or trying to do more and more, for the lack of a better word, you know, mishap-type of activities. More process sort of, not testing, not evaluating the process, but maybe discovery through process and I've been trying to make activities where students need to read through some specific directions and it's got, you know, and they'll have this is what you do next and then do this. They need to read through and then answer questions, do research, and hopefully come up with some answers on their own, some formulas, or whatever we're working on their own or in their groups rather than me just lecturing

I would say I teach in a more constructivist, problem approach where the students are working on some kind of major idea, but they're kind of constructing their own knowledge just through different experiences that they have.

I always try and plan lessons that go for concept and process not product.

And, regarding assessment, Ms. McDonald and Ms. Phillips stated, respectively, I think that I am able to come up with different ways of seeing of assessing the kids. We do a lot of discussion type things. I write a lot of notes when they're speaking to me. Usually at my school, teachers rely on your usual written, fill-in the blank space, and circle the answer kind of tests. I do a lot more activities or teamwork or some kind of an activity that draws out their knowledge. I have them assess themselves all the time.

I use rubrics a lot. I kind of base them sometimes on the ones that my MCTP science methods professor would do in glass to grade things. Rubrics, I have the kids' right journals every week. In earth science they have a journal due. Either I give them a topic, or they have to do a free write about anything in earth science, so those are two things that I think I kept from MCTP, things that I like to use.

This theme of innovation in mathematics and science teaching flowed throughout all the new teachers' reflections on what they intended to do in their practices. The primary need these new teachers had, therefore, was a workplace that supported these intended practices.

Capabilities. The new reform-prepared teachers were prepared to enact reform in mathematics and science practices when they entered the workplace. A common theme we detected was how the new teachers constructed a favorable perspective of their capabilities (level of content knowledge and abilities in reform-based pedagogy) by comparing themselves in their workplaces with the perceived capabilities of their non-MCTP prepared teaching colleagues. Regarding their perceived content abilities in mathematics and science, Ms. Lee, Mrs. Kern, Ms. McDonald, Mr. Smith and Ms. Phillips stated, respectively,

I even noticed that I have more content knowledge in math and science, more than the veteran teachers that are here. And they're finding that they need to ask me some science-related questions. I'm not saying that I am the guru and the expert here on science but I find that I'm pretty prepared for the content area.

I think I came into teaching with a much stronger background and I'm stronger at developing lessons, and I think it has more to do with the Collaborative than anything. Because there are several new teachers here at my school and every person that has talked with me has said that I kind of am better established for a first year teacher.

I think that I tend to focus more on the MCTP way of teaching math; whereas, a lot of the teachers are still doing the old, you know, worksheet answer it, turn it in system. I would say I teach in a



more constructivist, problem approach where the students are working on some kind of major idea, but they're kind of constructing their own knowledge just through different experiences that they have. I use a lot of manipulatives and that kind of thing.

I think the kids notice my [content preparation] also because sometimes, like either in math or science, I'll relate things to things we're doing in science or to things that we're doing in math. Like, I don't know, just talking about, I think the other day in math we were talking about distance and scientific notation and I was talking about distance to planets and looking at the angles of planets, and how people used to measure how far away stars were and all this stuff. And they'd say, "How is it that you know this? You're a math teacher. And, oh, that's right. You're a science teacher, too." So I can bring things from one area to the other and use them in class. Whereas I don't know if all people would have had that training or even know to think to bring something like that up.

In regards to their teaching performance level, the new teachers saw themselves increasingly over time spent in their workplaces as advanced in comparison to new and veteran teachers. This common perspective was articulated succinctly by Ms. McDonald,

I think I'm a little bit more confident in teaching math and science than other teachers, other new teachers, and even other, you know, current teachers. The MCTP gave me a lot more experience and ideas, I think, to draw from.

*Institutional demands.* Three of the participants in this study were employed as elementary teachers with teaching responsibilities in all disciplines; two were employed as middle school teachers (one as a mathematics teacher and the other as a mathematics and science teacher). Three of the teachers remained in the study the second year (two elementary and 1 middle level); two changed schools (one within district, the other out-of-state). What follows is an examination of the individuals by select criteria based on our findings.

*Supports.* The supports identified by the new teachers were predominately individualistic by school context. A sampling of our findings provides evidence for this assertion.

For Ms. Lee, a primary support in teaching in the manner that she desired was her learning experience in her MCTP teacher preparation program. Specifically, the activities in which she participated in her science methods class and the way she was taught in her introductory physics class were valued. She stated,

I'm teaching an upper level math, a high group, and I'm using a lot of the activities that we did, the hands-on, constructivist activities that we learned in our courses, especially in the methods. I'm using a lot of those activities from [her science methods professor], because it goes along very nicely with the hands-on, constructivist curriculum, and the kids are doing great with it, and they enjoy coming to class....Also, our MCTP content classes were taught in a constructivist manner, so our learning was constructivist, too. They built on our prior knowledge, and those kinds of things, like, all these little facts that I learned in my MCTP Physics course. I didn't forget the knowledge, because the professor built a solid foundation of the science and the math. Those kinds of things I didn't forget, and I'm using that very nicely here in the classroom.

For Ms. Kern primary supports were district workshops on teaching for one statewide performance-based assessment in science and mathematics, school personnel who assisted with obtaining manipulatives for mathematics, and district supplied science kits. She stated,

In support of the MCTP ideas in my district they offer workshops. I went to the county science workshop at the beginning of the year, and they were helpful just to familiarize yourself with the way things are expected to be done to prepare students for the state performance examination. We had two mathematics state performance assessment workshops in which we took the bigger student performance math activities, and making smaller ones, so that we can, you know, use them regularly with the kids. I've used those workshops to kind of make up my own kind of things, like, using our school store price list to make up some problem solving things....School personnel help a lot. I have this person ...who does a whole lot for me by getting math materials ready. So I

get a lot of support in the math area. The science, I mean I can't say enough good things about the districts science kits.

For Ms. Phillips, she perceived that aspects of her district's curricula and her principal were supportive. She also attributed ideas she obtained in her MCTP mathematics and science methods courses as supportive in her teaching practices. She stated,

I have a principal who is very supportive of all the MCTP sort of ideas, so she was really excited with me coming in that I had had the math/science background.... I think that my district is supportive... I think that in my math methods and in my science methods I got a lot of ideas....

For Mr. Jones, supports he perceived were his principal and the mathematics manipulatives in his school. He stated,

My principal is very supportive... we have considerable amount of manipulative materials.

Mrs. McDonald expressed that her community (including her students' parents, her fellow teachers, and her administrators) were supportive of her practices throughout the study period. She stated, The student parents are so supportive...my community is highly, highly supportive....My teachers and other employees I would say, for the most part, are very ....My administrators are very supportive also.

The supports identified by the school principals were multiple, including their own. These supports included the reaction to the new teachers' practices by colleagues, students, and parents. The principals also voiced their appreciation of what the new teachers brought to their schools in oftentimes glowing terms, referring to nominations for "Teacher of the Year" in several instances. The following statements by Ms. Lee's, Ms. McDonald's, Ms. Phillip's, Mr. Jones, and Ms. Kern's principals, exemplify the administration's high level of support of the new teachers:

She's one of the best prepared people to take on [our school district's] public schools curriculum in those two areas [mathematics and science] that I've had the privilege of working with in the last, at least, ten years.... I nominated her, along with the PTA and other community members and staff, for the Sally May First-Year Teacher Award. It's a very prestigious award. It's a national award. To put it in a better perspective I've never nominated a first-year teacher for an award, for the Sally May Award or those types of awards. I never felt that I had one that was of this caliber. [Ms. Lee's Principal]

Miss McDonald was nominated through the parents, primarily, but also through commitment of support from her colleagues and by me for Teacher of the Year. Not New Teacher of the Year, but Teacher of the Year. And this is quite an honor.

But one of the things that impressed me about her when I interviewed her, as well as the times that I've observed her, is she makes connections between math and science. And that to me is exciting. Is this math or is this science. That's what makes it real world and seamless. And that's the other thing that I see her really trying to do ñ making connections for the students in their real world. And, her confidence and her commitment are above. I mean I even remember the moment I interviewed her, it was a team interview. I usually involve a team of people that would be working with her and that person would be working with. And it was, like, Wow! What a breath of fresh air. [Ms. Phillip's Principal]

I have a letter that went into Mr. Jones's file from a parent who was completely satisfied with her child's mathematics program and the support Mr. Jones gave that child. And that child was not a student in one of his more advanced classes. I think Mr. Jones had the support of parents. I think for students who were really willing to put forth a positive effort, Mr. Jones had the support of students. For those students who did not, they probably didn't appreciate Mr. Jones because he kept after them for greater excellence.

She was responsible for teaching science, also. And she did a great job with that. The way the science curriculum is set up in the County, there is a lot of integration already in the activities that are expected in the science units. She was very much at ease, attended the science training for each of the three major units that are taught in the 3rd grade. And would then relate back for means of understanding or explanation in math, some of the activities that they had done in science. Because if the children were graphing in science, for example, when she was doing her math lesson, she would refer back to the activities they had done in science class, that kind of thing. [Ms. Kern's Principal]

**Constraints.** The constraints identified by the five new teachers as they began their first year of practice for reform-based practices were individualistic. They included: non-solicited ideas on how to change the participant's practices; the number of mathematics objectives to meet; the shortage and availability of computer equipment; the diverse level of student abilities; the science kits' prescribed curriculum and schedule; the prescribed science and mathematics curricula; the district's ongoing student testing of instructional outcomes; the number and extent of standardized student testing; the more experienced teachers' expectation that the new teacher would become less active and less innovative with time; the suspicion of parents to new ideas in assessment.

Exemplar new teacher quotes (abbreviated—complete quotes reported earlier in this paper),  
We don't have a computer lab; we just have a media center, so classes come in for twenty minutes book exchange.... [Ms. Kern]

I don't like having to use the [district instructional outcomes tests]. Those don't support, I mean, anything that I think I learned while I was in college. And it just drives me nuts having to really do these.... [Ms. Phillips]

It's not as easy, you know, as you think it would be, to make connections between math and science, because in my county the two curriculums are meant to be so distinct... [Ms. McDonald]

Constraints identified by the five participants in the spring of their first year of teaching were diverse. These included: student expectations of being taught in a non-reform based manner; standardized student testing; communication with non-English proficient student parents; availability of technology equipment; student subject rotation from teacher to teacher; prescribed curriculum and schedule of the science kits; student standardized testing of short-term instructional outcomes; diverse abilities of the students; team concept of teaching; excessive parental involvement. Exemplar new teacher quotes (abbreviated—complete quotes reported earlier in this paper),

Lots of the teachers here are much older and may have been in the profession for a long time, and so they do a typical worksheet thing, and they do the note taking and not so many of, like, cooperative learning things. And, there is a lot of direct instruction.... [Ms. Lee]

Math and science, or math and anything else, and so I kind of feel like in order to be successful in making connections like that you need to have the same group of kids. And at least for half the day.... Every 40 minutes I have a different group in the afternoon. [Mrs. Kern]

A constraint is all of the testing and things. I think that my county is really test happy. We just have so many tests for everything. All the time tests and quizzes. And right now, basically, the rest of the year it's, like, forget about it for any doing any real teaching..... [Ms. Phillips]

You know, I think honestly, I feel like it's been a wasted year in applying what I learned in the MCTP program. I shouldn't say totally wasted. But I haven't come to fruition, obviously. You know, I want to be positive, but I keep thinking of my experience, and I'm looking back, looking at how my year went what I was dealing with the first semester. And I think, boy, it's a good thing I got anything done. The target kept moving, the curriculum kept changing.... Those outcomes are really constricting, very constricting to do the MCTP type of teaching. [Mr. Jones]

I think there's also this desire from the parents that everything is the same across the board, like, all the third graders are getting the same, you know, type of instruction, they're all getting the same quality, I think, is what they're really after. So I think that unless I can get my team members to do a lot more of what I'm doing, I can't do so much of it....[Ms. McDonald]

The constraints identified by two of the three participants who remained in the study the second year of teaching were individualistic. These included: diverse student ability level; the lack of organization in the science curriculum; a teaching assignment that required multiple levels of subject preparation and several subjects; and a perception that a major role of the teacher was to achieve increased student performance on standardized tests. Exemplar new teacher quotes (abbreviated—complete quotes reported earlier in this paper),

And last year my principal was really different. She was real, real, real supportive and, not that my new principal isn't, but he is so data driven that all he sees is numbers. That's all he sees. And so that's been real, real frustrating this year. [Ms. Kern]

I thought it would be easier this second year. I mean they really told me I'd have an easier load. I don't teach Life Science anymore, which I'm thankful for, but I'm moving around now even more than I was. I'm only in two classroom, but I'm back and forth four times, instead of moving three times as I did last year. This time, I'm like back, forth, back, forth, four times. Three of Earth Science classes, two of math. And I have some GT this year for science. I have one cluster class. I have one GT class, and I have one low-level regular class of science.... Nobody has any idea what I do in math. Nobody cares what I do. I mean, maybe test-wise they care. [Ms. Phillips]

The constraints identified by the school principals varied by individual. In two cases (Ms. Lee and Ms. McDonald) the principals could not identify any constraints. In one case (Mrs. Kern), the constraints identified were not in the perceived abilities the new teacher brought to the school. Instead, the constraints were associated with the culture of the schools. In two cases (Ms. Phillips and Mr. Jones) the principals identified both participant and school culture constraints. Exemplar principal quotes,

Laura worked through what ended up being a very difficult situation on her team. The third grade team last year consisted of five teachers. We had five sections in third grade. And three of the teachers were new to the school. Laura was the only first-year teacher on the team, two other teachers who were veterans, joined us from another jurisdiction. So they were new to this system's culture....[Ms. Kern's principal]

...This school [recently] was an intermediate school. It became a middle school, and I think we have, particularly at the 8th grade, a culture that sometimes doesn't feel quite like middle school. It still has a traditional junior high culture and we have certainly been trying to make a change in that. Make a shift. But there's some hard-core staff here, and Katie has had to work with those people and I hope, not been too negatively influenced...[Ms. Phillip's principal]

I'm going to say that the County school system and I guess that would include me as well in some ways supported Mr. Jones but also failed him....An example of that is that Mr. Jones and I agreed to his first semester evaluation, which identified three areas of areas to improve upon for second semester. They were all documented areas to improve, with ways to improve and Mr. Jones agreed that they would be areas to focus on for second semester. I feel that out of the criteria (there were ten criteria) that seven of them were effective and three of them were areas to focus and improve upon. I think it would be unrealistic to be able to think that a brand new, first-year teacher would be effective in ten categories they're first semester doing the job. So we agreed with that, and yet the county, following their guidelines for evaluation of teachers, sent Mr. Jones a letter in January stating that because he received three areas of needs improvement, that he would have to improve or he would face dismissal at end of school year....I think he felt betrayed by the school system. [Mr. Jones' principal]



## Conclusion and Implications

While definitive conclusions must be postponed until additional studies are conducted that enlarge the number of participants and contexts examined in this small-scale in-depth hypothesis generation case study, our findings suggest research directions that warrant continued exploration.

Our elementary and middle level mathematics and science teachers entered the workplace with the capabilities and intentions to enact reform-based practices. They placed a high value on their reform-based teacher preparation program. This finding differs from what Simmons, et. al. (1999) reported in their study of beginning teachers' beliefs. Our analysis of how the new teachers taught and what they thought about while teaching in their first years of teaching suggests several ways that their practices may be strongly influenced by their perspectives of school culture. This finding supports an emerging body of research that posits "schools have served as powerful discourse communities that enculturate participants (students, teachers, administrators) into traditional school activities and ways of thinking (Putnam & Borko, 2000). In school cultures in which the new teachers believed they were supported by powerful members of the culture to enact reform, they flourished (e.g., Ms. McDonald and Ms. Lee). However, similarly to Lacey (1977) (as cited in Veenman, 1984, p. 163) in less supportive school cultures we found that as our new teachers became enculturated (or socialized) into their schools, they implemented "social strategies" to respond to perceived constraining structures. Social strategies are action individuals take in reaction to perceived coercive power in a community setting. The social strategies the new teachers developed were *resistance*, *moving on*, and *exit*. These strategies were not mutually exclusive, but were used as the new teacher's thought appropriate in response to specific instances of perceived power in their school cultures.

**Resistance.** In several instances the new teachers expressed resistance in their actions toward traditional ways of thinking about mathematics and science teaching they detected in their school cultures. For example, in Ms. Kern's second school culture, her principal placed an emphasis on an increase of instructional time devoted to district instructional outcomes testing. This conflicted with Ms. Kern's view of how to use instructional time for student-focused activities. Her social strategy was to question her principal in a staff meeting about his perspective. She stated,

My principal, or someone else, has formulated that according to the children last year who took the [statewide standardized exams], all the children who were every quarter at that 2/3 mark on the district instructional outcomes or better or higher, met proficiency on [the statewide test. So he's saying that this year that should be our goal. But it's a different set of children, was my argument to him. And he said, "Well, I guess mathematically speaking, you're right. But there's no harm for you guys to set that as a goal for your class."

In another example, in Ms. Lee's case when several veteran teachers reacted negatively to some of her reform-informed ideas, Ms. Lee spoke defended to them her reform-based practices. She stated, We had a team meeting, and they [her teacher teammates] came up to me, and they just said, I mean, of course they were positive at first, I mean, we get along very well, but then they're starting to say things like, they think that my method is just a little bit, well, they think they *cover* [participant's emphasis] more things. I said, "Well, you may cover more things and they may remember it short-term, like on short term to take a test, but what about later on when you're building from it?"

**Moving on.** In one case when the perceived instances of coercive power became a preponderance, the new teacher began to consider options on how to stay in teaching within her school district but leave the immediate school culture. The new teacher's social strategy to improve her situation in a school culture that she (Ms. Phillip) found problematic, was to consider transferring within district, moving on, to another school<sup>1</sup>. She stated,

But this, I mean, maybe somewhere else. Maybe I'd like to transfer schools. But I think that the emphasis coming down from the top down is just not where I want it to be.

<sup>1</sup> In the spring 2000, Ms. Phillips informed the researchers that she was transferring schools, beginning in the fall 2000, to another middle level school in her district. She was pleased to share that she would be "teaching 8<sup>th</sup> grade science in my own classroom!" (Ms. Phillips, personal communication)

Exit. Finally, in our examination of five new teachers, a social strategy that one took was to remain in teaching but to leave the larger context of his school culture, district, and state<sup>2</sup>. Mr. Jones' social strategy in a situation that he found overwhelmingly constraining was to exit his school, district, and state for another teaching position out of state on a Native American Reservation. From his principal's perspective, Mr. Jones' social strategy was unfortunate. He stated,

Mr. Jones may have been a year too early arriving in our math program. I think our math curriculum [during Mr. Jones' first year] did not support what the Third International Math and Science studies supports or what I believe your program [MCTP] supports. However, this year in 6th grade, the year that Mr. Jones will not be here, we are going to institute a pilot program of a new curriculum called Connected Mathematics, which is a well-respected innovative curriculum received by the National Science Foundation Awards. We're going to pilot that program here at my school, which I thought would have been very consistent with your program goals.

We draw several implications from this study of new teachers' practices in different schools in the same school district.

First, our research suggests that a reform-oriented mathematics and science teacher preparation program can recruit, educate, and graduate a cadre of new teachers who are employed by school districts. Our rich documentation presents evidence that new teachers from such a teacher preparation program have the capabilities and intentions to teach mathematics and science in a reform-based manner that makes connections between the disciplines by using high quality science mathematics.

Second, our research suggests that the school context in which the new teachers began their teaching practices is a major factor in whether reform-aligned mathematics and science teaching is regularly implemented. The supports and constraints an individual teacher encounters on a daily basis, particularly from individuals with potential coercive power over their work lives, are noticed by new teachers and influence their curricular, instructional, and assessment actions.

For example, in the cases of Ms. Lee, Ms. Kern (1<sup>st</sup> year) and Ms. McDonald, when the new teachers perceived support for how they intended to teach by the school cultures (with the primary determinants being the principal, the students' parents, and the district's curricula), the result was favorable for reform-based practices in mathematics and science. In the cases of Mrs. Kern (2<sup>nd</sup> year), Ms. Phillips, and Mr. Jones, when the new teachers perceived a mismatch between how they intended to teach and the school cultures (with the primary determinants being the district's curricula and assessment), the result was not favorable for reform-based practices.

Finally, if our findings are supported by future research, to enact reform and to retain new reform-prepared teachers a key implication is that the new teachers fare better when they are employed in supportive, reform-oriented school cultures rather than in other environments. While our findings indicate that in situations in which reform-based teaching is discouraged some reform-prepared new teachers do not leave but elect to continue their careers in teaching by altering their practices to fit in with extant traditional practices, the loss of reform in those contexts is a costly impact. We posit that if better matches are made initially between reform-prepared teachers and school cultures, the extent and the quality of reform-based practices in mathematics and science teaching will increase as will the retention of more newly prepared teachers within school cultures. We also wonder what can reasonably be done in teacher preparation to more adequately prepare new, reform based teachers to enact reform-based practices in school cultures that are not initially supportive?

In addition, although much literature on new teachers (particularly in science education) supposes that new teachers proceed in a similar developmental stages of concern manner (see Spector, 1989 and Ryan, 1986), our research points in a different direction, a socialization perspective that is increasingly prominent in the mathematics literature (see, Brown and Borko (1992) and others). The socialization

<sup>2</sup> Another social strategy that Ms. Phillips was beginning to consider, but not enacted was to *depart* teaching as a career. She stated,

I know that one of the things that MCTP is concerned about is keeping teachers in teaching and making them want to stay. But I just don't know if this is what I'm going to want to do forever. I just can't tell. I cannot foresee myself doing this when I'm 40 years old. I just can't.

perspective offers a view of what potentially can happen in their induction years to newly prepared reformed-based teachers. This theoretical perspective underscores the need for additional attention toward alerting new teachers as to the potential consequences of accepting employment in different types of environments. Additionally, another consequence may be to argue for enhanced support for reform within school cultures by reform-oriented personnel within school cultures.

Conversely, when a principal inadvertently exposed a new teacher to administrative censure for not teaching in a traditional manner, the result was adverse. The new teacher, Mr. Jones, chose to leave his school and district rather than continue to continue employment in that school culture. Also, when a new teacher, Mrs. Phillips, determined the district recommended assessment structures to be in conflict with her construction of reform-based instruction and assessment, she increasingly began to consider transferring from her immediate school culture and reevaluating if teaching was a long term career choice.

Consequently, the major finding from this study is that while teacher preparation could send forth newly prepared "good seed" teachers, the primary limiting factor as to the long term extent and success of the new teachers in enacting reform was the school culture in which they practiced. School cultures (consisting of principals, teachers, students, student guardians, and district curricula and assessment demands) that actively supported and respected the reform-orientation of the new teachers resulted in the most contented, stable, and effective personnel. In non-supportive school cultures, the opposite resulted.

Finally, while we would like to attribute conclusively to the MCTP the positive aspects we observed and heard others mention of our participant teaching practices, we resist that temptation. Each of our participants was self selected to the program and brought along individual talents, hopes, aspirations, and beliefs. Separating the impact of their reform-based teacher preparation program from what the participants brought to the program was not possible. However, we could document from multiple viewpoints how the MCTP new teachers have fared and were perceived by many of the players in their teaching cultures. An important finding was that the MCTP new teachers did intend to and did attempt, to varying levels of extent and success, the reform-based goals of the program. Their school cultures varied, however, in how nurturing and supportive they were in hosting reform-based instruction in mathematics and science.

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#### Author Note

This research was supported by two grants from the National Science Foundation's Collaboratives for Excellence in Teacher Preparation Program (CETP), DUE 9255745 and DUE 9814650.

We would like to gratefully acknowledge the generosity of the new teachers who participated in this study. The first years of teaching practice typically leave little room for additional obligations outside of immediate work obligations. We believe that their commitment to research as a way of professional development offers our profession one vision of how the world of work and academia can support each other during the induction years.

Table 1  
First Year 1st and 2nd Telephone Interview Protocol

1. To what extent (and in specific ways) do you think what you learned in your MCTP teacher preparation program has impacted how you are now teaching mathematics and science?

Probe:

- teaching for understanding
- making connections between mathematics and science
- using technology
- using alternative assessment

2. In comparing your teaching of mathematics and science with other teachers at your school (both veteran and new), what ways do you think your teaching is the same/different?

Probe:

- teaching for understanding
- making connections between mathematics and science
- use of technology
- alternative assessment

3. To what extent does the culture of your school (which includes school personnel, students, parents of students, and county expectations):

- a. support your efforts to implement the ideas on teaching mathematics and science promoted by the MCTP?
- b. place constraints on your efforts to implement ideas on teaching promoted by the MCTP?

Table 2

Year One Focus Group Interview Protocol

Earlier, in individual interviews, we asked you these 3 questions:

1. To what extent (and in specific ways) do you think what you learned in your MCTP teacher preparation program has impacted how you are now teaching mathematics and science?

2. In comparing your teaching of mathematics and science with other teachers at your school (both veteran and new), what ways do you think your teaching is the same/different?

3. To what extent does the culture of your school (which includes school personnel, students, parents of students, and county expectations):

- a. support your efforts to implement the ideas on teaching mathematics and science promoted by the MCTP?
- b. place constraints on your efforts to implement ideas on teaching promoted by the MCTP?

Tonight, could you share your thoughts on:

1. Instances on when you have taught successfully this year in a MCTP manner?

2. Thoughts on to what extent you think teaching in the MCTP manner fits in with how mathematics and science instruction is typically carried out in your school?

Probe: Supports and Constraints



Table 6

Participants' Principal Interview Protocol

Could you please comment on the teaching practices of [study participant in this school]?

1. To what extent (and in specific ways) do you think the new teacher:

- teaches for understanding
- makes connections between mathematics and science
- uses of technology
- uses alternative assessment

2. In comparing the study participant's teaching of mathematics and science with other teachers at his/her school (both veteran and new), what ways do you think the study participant's teaching is the same/different?

Probes:

- teaching for understanding
- making connections between mathematics and science
- use of technology
- alternative assessment

3. From your perspective, to what extent does the culture of the study participant's school (which includes school personnel, students, parents of students, and county expectations):

a. support the study participant's efforts to implement the ideas on teaching mathematics and science promoted by the MCTP as:

- teaching for understanding
- making connections between mathematics and science
- use of technology
- use of alternative assessment?

b. place constraints on the study participant's efforts to implement ideas on teaching promoted by the MCTP?

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Table 7

Second Year Individual Interview

1. What do you know now (as a beginning 2nd year teacher) about teaching mathematics/and or science that you did not know when you started your first year of teaching?

2. Do you think your enhanced content knowledge preparation (greater number of mathematics and science course, more in-depth focus in MCTP content classes) impacts:

- a. the way you teach (planning, delivery, assessment)?
- b. your students performance?



Table 8

2nd Year Focus Group Protocol

We have earlier asked you these 3 questions:

1. To what extent (and in specific ways) do you think what you learned in your MCTP teacher preparation program has impacted how you are now teaching mathematics and science?
2. In comparing your teaching of mathematics and science with other teachers at your school (both veteran and new), what ways do you think your teaching is the same/different?
3. To what extent does the culture of your school (which includes school personnel, students, parents of students, and county expectations):
  - a. support your efforts to implement the ideas on teaching mathematics and science promoted by the MCTP?
  - b. place constraints on your efforts to implement ideas on teaching promoted by the MCTP?

We have also asked you to share your thoughts on:

1. Instances on when you have taught successfully this year in a MCTP manner?
2. Thoughts on to what extent you think teaching in the MCTP manner fits in with how mathematics and science instruction is typically carried out in your school?  
Probe: Supports and Constraints
3. Discussion on survey--did any items prompt further thinking?

**Today, mid-year during your second year of full time teaching, we are especially interested to hear your responses to this query:**

From your perspective as 2nd year teachers:

- a. What most influences you now on how you teach mathematics and science?
- b. Looking back, what have you taken from your MCTP program (if anything) that impacts the way you think about mathematics and science and how to plan for/teach/assess those disciplines with elementary/middle level students?

Probe: An example.

Probe: Any changes in your perspective since last year?

Table 9

Demographic Information

	Rock Hill (K-5) (Mrs. Kern, 1 <sup>st</sup> Y)	Lincoln (6-8) (Mr. Jones)	Rider (K-5) (Mrs. Kern, 2 <sup>nd</sup> Y)	Glen Oaks (K-5) (Ms. McDonald)	East View (6-8) (Ms. Phillips)	Overlook (K-5) (Ms. Lee)
African American	55%	30%	21.2%	5.9%	14.1%	28.5%
American Indian	0.3%	0.3%	0.3%	0.2%	0.1%	0.5%
Asian	8.5%	11.4%	16.7%	29.1%	6.9%	7.6%
Hispanic	24.2%	20.1%	8.7%	2.3%	13.9%	42.2%
White	11.9%	38.3%	53.1%	62.5%	64.9%	21.2%
Special Ed	5.4%	21.9%	8.9%	7.7%	12.2%	10.4%
International	13.8%	18.4%	7.1%	7.7%	17.4%	10.9%
ESOL	9.6%	4.4%	2.5%	3.3%	6.1%	12.8%
Free or Reduced Lunch	59.5%	30.2%	24.0%	6.6%	17.1%	62.2%
Mobility Rate	37.4%	19.8%	25.9%	9.8%	8.2%	24.1%
Attendance	95.2%	94.6%	95.8%	96.6%	94.6%	94.6%

Table 10

## School Criterion Reference Test Results

% Meeting Standard	Rock Hill (K-5) (Mrs. Kern, 1 <sup>st</sup> Y)	Lincoln (6-8) (Mr. Jones)	Rider (K-5) (Mrs. Kern, 2 <sup>nd</sup> Y)	Glen Oaks (K-5) (Ms. McDonald)	East View (6-8) (Ms. Phillips)	Overlook (K-5) (Ms. Lee)
Gr 3 Reading	43%	76%	63%	83%	80%	49%
Math	30%	64%	52%	85%	66%	53%
Gr 4 Reading	47%	62%	69%	87%	79%	58%
Math	33%	59%	38%	66%	78%	68%
Gr 5 Reading	58%	69%	69%	85%	80%	62%
Math	31%	55%	47%	85%	70%	58%



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EFF-089 (3/2000)